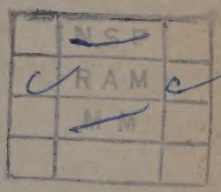
FEDERAL REPUBLIC OF NIGERIA

Annual Report on the Department of Agricultural Research

FOR THE YEAR 1964-65



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ANNUAL REPORT ON THE DEPARTMENT OF AGRICULTURAL RESEARCH FOR THE YEAR 1964-65

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FEDERAL DEPARTMENT OF AGRICULTURAL RESEARCH

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F.A.O. SOIL FERTILITY EXPERT	T. Heikennen, PH.D.

ANNUAL REPORT ON THE DEPARTMENT OF AGRICULTURAL RESEARCH FOR THE YEAR 1964-65

REPORT BY THE DIRECTOR OF AGRICULTURAL RESEARCH

INTRODUCTION

Policy and development

The established policy of the Department of Agricultural Research is to raise the productivity of Nigeria's staple food crops by research into the improvement of the plant material, the control of plant pests and diseases, and the better nutrition of the plant and the soil. In 1964, as in previous years, the research programmes of the Department reflected this policy and were vigorously pursued to the limit of the staff capacity and research facilities. It is disappointing therefore to have to record that neither of these factors showed any significant improvement in 1964-65, though in part this reflected the imposition of certain temporary austerity measures by Government which have since been lifted.

However these difficulties did not deter the Department from pursuing its plan to establish regional sub-stations for rice research at Warri in Mid-Western Nigeria, at Bende in Eastern Nigeria and at Birnin Kebbi in Northern Nigeria. The first station will facilitate research in the fresh water mangrove swamp environment while the second station will enable breeding and selection of rice varieties to be carried out under the climatic conditions of Eastern Nigeria. The station at Birnin Kebbi serves the deep flooding river valleys of the far North. Comprehensive experimental programmes were successfully established in the field by the Senior Officers posted to these stations. It is regrettable that no parallel progress occurred in the construction of the laboratory and ancillary buildings for these stations owing to the non-release of the planned capital provision.

The old Chemistry Laboratory at Moor Plantation, built in 1926 and lying gutted and empty since 1961, was structurally renovated and completely re-equipped with laboratory furniture and essential services during the year. This was made possible by temporarily imposed economies in the recurrent expenditure of other Divisions as, again, no capital was available. Good progress was also made in the recruitment and training of laboratory staff and the new facilities for research in the inorganic, organic and spectrographic chemistry of soil and plant nutrients were being fully utilized by the end of 1964.

Close collaboration was maintained with the other Regional Ministries of Agriculture. Most encouraging of all, the fifteenth meeting of the Agricultural Technical Committee, held in Benin in February 1965, again devoted much of its time to the essential voluntary co-ordination of the related programmes of agricultural research of the Regional Ministries of Agriculture, University Faculties of Agriculture and the Commodity Research Institutes. An Index of Research for 1964-65, compiled from the co-ordinated research programmes submitted and reviewed at the fourteenth meeting of the Agricultural Technical Committee, was published during 1964 and was well received, both in Nigeria and abroad.

Staff

Although the Department's overall staff position showed a considerable improvement with 86 per cent of the established posts filled as compared with 78 per cent in 1963-64, this improvement was confined to the technical and clerical cadres. The position in the professional cadres worsened. A most unwelcome reduction in the professional establishment, imposed by Government for reasons of economy, left the percentage of professional vacancies unchanged but, in fact, the number of scientists was reduced from thirty-six to thirty during the year.

Furthermore the increasing demand for staff from numerous other organisations participating in agricultural research, is resulting in a shortage of suitably qualified graduates in pure science that is likely to persist for some time.

A warm welcome was extended to the following new members of staff who joined the Department during 1964-65 : Dr W. M. Tahir, Principal Research Officer, Botany Division; Dr M. L. Jerath, Senior Research Officer, Entomology Division ; Mr A. Williams, Research Officer, Rice Research Unit; Mr L. I. Okafor, Research Officer, Rice Research Unit; Mr M. A. Soneye, Higher Executive Officer, Head Office ; Mallam M. L. Abdullahi, Higher Executive Officer, Head Office ; Mrs O. F. Ojo, Library Officer, Head Office.

We also welcomed the return of Dr M. N. Okafor and Mr S. O. Boboye, Research Officers, who resumed duty after the completion of their in-service training.

It is with regret that we have to record the retirement of Mr F. A. Squire, Principal Research Officer, Entomology Division, after more than thirty years' service in various parts of the Commonwealth ; of Mr A. Waitt, Senior Research Officer, Root Crops Research Unit ; of Dr M. Nwaji, Senior Research Officer, Chemistry Division and Miss N. Shinie, Librarian.

The authorised establishment of the Department for 1964-65 and an analysis of the progress in recruitment, Nigerianisation and in-service training is given in Appendix I.

Overseas technical assistance

The Department continues to be grateful to many overseas international bodies for their assistance and co-operation. The visit of Dr F. J. Simmonds, Director, Commonwealth Institute of Biological Control proved particularly valuable in focussing renewed attention on several Nigerian pest problems which might favourably respond to biological control. As one result, a joint project between the Department and the Institute was initiated to study the prospects of biologically controlling the yam beetle.

The Department also received valuable advice on the operation of the Federal Plant Quarantine Service from Messrs H. Shirakawa and E. Pierce of the United States Department of Agriculture Plant Quarantine Service. The three month visit of these experts, who also drew up a syllabus for a Plant Quarantine Inspection training course, was generously financed by the United States Agency for International Development.

Mr Rolf Bjerke, F. A. O. Soil Fertility Specialist, arrived in March 1965 to take over the Freedom from Hunger Campaign fertilizer demonstration programmes in Western, Mid-Western and Eastern Nigeria from Dr. T. Heikkinen who finished his assignment in May 1965. Mr Bjerke, who is accommodated in the Department's Division of Agronomy, accepted an invitation to participate in the planning and execution of the Department's agronomy programmes, an aspect of the F.F.H.C. assignment somewhat overlooked in the past.

An agreement was drawn up in December 1964 between the United States Department of Agriculture, U.S.A.I.D. and the member nations of the Scientific, Technical and Research Commission of the Organisation of African Unity to provide for a ten year Cereals Improvement Programme in West Africa. Under the terms of the agreement the Department of Agricultural Research and the Institute for Agricultural Research will both receive assistance in the form of experts, housing, equipment and financial aid to supplement the research currently being carried out in Nigeria and other West African territories on sorghum, millet, maize and grain legumes. A maize pathologist is currently expected to arrive at Moor Plantation in June 1965.

Conferences and extra-Departmental activities

The extra-Departmental responsibilities of the Director of Agricultural Research occasioned his frequent absence from Headquarters during 1964. In August he accompanied the then Minister of Economic Development, the Hon. Alhaji Waziri Ibrahim, on an extensive tour of agricultural development projects and Federal research stations in Eastern Nigeria. A similar tour was undertaken, this time in Western Nigeria, in March 1965.

In September 1964 the Director attended, as a member of the Nigerian delegation, the Third F.A.O. Regional Conference for Africa at Addis Ababa, Ethiopia.

In November, the Director, accompanied by Mr E. A. Dosunmu, Higher Technical Officer and Mr J. A. Obi, Technical Officer, attended the Eighth Meeting of the Inter-African Phytosanitary Commission at Yaounde, Cameroun Republic. At the meeting Mr Okiy was unanimously elected President of the Commission for the following two years. Subsequently, the Director attended the annual meeting of the Agricultural Advisory Council of Eastern Nigeria and, in December, the annual meeting of the Science Association of Nigeria.

The second annual meeting of the Departmental Research Reviewing Committee was held at Moor Plantation, Ibadan in early December at which the progress of research projects in 1964 was reviewed and the programme for 1965 was discussed and finalized. This was followed by the attendance of Departmental delegations, led by the Deputy Director, at the annual 'Cropping Committee' meetings of the Regional Ministries of Agriculture. Here, details of the Department's own experimental programmes at crop research centres all over Nigeria were co-ordinated with the various Regional authorities.

Mr D. Archibong, Research Officer (Legume Breeder) attended the first F.A.O. Technical Meeting on Vegetable and Grain Legume Production in Africa, held at Dakar in January 1965.

In February 1965 the 15th Meeting of the Agricultural Technical Committee was held at Benin under the chairmanship of the Director. It was attended by nine members and fifteen observers representing all the Provincial Ministries of Agriculture and the Faculties of Agriculture of the Universities of Ibadan, Nigeria, Ife and Ahmadu Bello. The meeting reviewed the proposed 1965/66 research programmes of the participating bodies in order to co-ordinate the research effort and eliminate unnecessary duplication of research.

Again, in February, the Director attended, as a Member of the Governing Councils, the Inaugural Meetings of the Governing Councils of the Nigerian Institute for Oil Palm Research and the Cocoa Research Institute of Nigeria.

Visitors

Amongst the numerous distinguished visitors to the Department and its sub-stations were included the Hon. Alhaji Waziri Ibrahim, the then Federal Minister of Economic Development; Sir Francis Cumming-Bruce, the British High Commissioner in Nigeria; Dr O. E. Fischnich, Assistant Director-General, Food and Agriculture Organisation, Rome; Chief Akin Deko and Dr F. W. Hauck of the F.A.O. Regional Office; Mr A. O. Adetola, Secretary-General of C.C.T.A., Lagos; Dr F. W. Simmonds, Director, Commonwealth Institute of Biological Control, Trinidad; Mr T. A. Phillips, Commonwealth Development Corporation, London; Mr P. C. Chambers, Land Resources Division, Directorate of Overseas Surveys, London; Drs Bradfield, Ballow and Lindsey of the Rockefeller Foundation and a distinguished visiting delegation from the American Academy of Sciences.

The Root Crops Research Unit was particularly honoured by a visit from Dr M. I. Okpara, the then Premier of Eastern Nigeria, on 11th September, 1964.

Dr Herbert Green

The personal interest shown by the numerous but no less welcome visitors in the work of the Department is a much appreciated source of encouragement. It is therefore with great regret that we have to record the death of Dr Herbert Green of the Rothamsted Agricultural Research Station. Dr Green, who died in Lagos while undertaking a visit to Nigeria which would have brought him to Moor Plantation, was an old and trusted adviser of agriculturalists in Nigeria. His death leaves a gap which will not be easily filled.

REVIEW OF RESEARCH

Crop improvement

During 1964 a number of long term projects in the field of crop improvement were successfully concluded and recommendations were made to the Extension Divisions of the Regional Ministries of Agriculture (*see* Appendix IV).

On the basis of a series of trials carried out in numerous localities over several years, the 'synthetic' maize variety NS-1 and the introduced variety EAFRO-231 have been recommended to the Western, Northern and Eastern Regions. While EAFRO-231, a white floury flint variety, was introduced into Nigeria in 1956, the synthetic variety NS-1, a yellow flint, was originally derived by a gametic selection scheme from a collection of Trinidad varieties in 1957. Though it became evident during its development that, despite its yield potential, NS-1 was not generally acceptable for human consumption by Nigerian standards its release now coincides with the growth in demand for a feedgrain for the rapidly expanding poultry industry. Furthermore, the development in breeding techniques since NS-1 was created has resulted in the present generation of floury synthetic varieties, now undergoing trial, which conform much more closely to the criteria of acceptability.

A number of rice varieties have also been recommended (*see* Appendix IV) for specific areas on the basis of several years' trial. The introduction of a white-grained, floating variety of *Oryza sativa* in the last existing ecological strong-hold of the indigenous species *Oryza glaberrima* is of particular economic value to an area whose vast potential has, despite considerable past attention, remained unrealisable until now. It will be noted that the Rice Research Unit is still pursuing the problem of an even better adapted variety for this and similar naturally inundated areas.

The serious problem presented by the appearance of virulent strains of the rice blast disease pathogen, *Pyricularia oryza*, had been met with a prompt response on the part of both the rice breeders and the pathologists. Fortunately a proven high yielding variety has been demonstrated to be highly resistant and with the aid of the relatively well developed rice multiplication scheme supplies of seed of this variety will rapidly reach the farmers.

Another significant recommendation that culminates a long programme of trials carried out since 1958 all over Nigeria is that of the local Ibadan variety of cassava known as Oloronto or acquisition 53101. Previously recommended for much of Western Nigeria, the recommendation is now extended to the Riveraine Provinces of Northern Nigeria. There is however a growing body of evidence pointing to the ever greater yield potential of cassava hybrids derived from 53101 such as 60447, 60506 and 60444 and further recommendations for the Western and Eastern Nigeria may confidently be expected by the end of 1966.

Crop protection

The use of chemical pesticides is seldom economically justified under the conditions of Nigerian agriculture and is even less likely to be so if an accurate knowledge of the life history and movements of the pest are not known. Much of the work of the Entomology Division during 1964 was of this fundamental nature and the benefit will be reaped in future years.

That such benefit will accrue is demonstrated by the Pathology Division's previous work on the *in vivo* and *in vitro* properties of the causal viruses of cowpea mottle and cowpea yellow mosaic diseases. This now has enabled the pathologist to screen many of the indigenous and introduced strains of cowpeas held by plant breeders in the Regions for resistance to these diseases. The number of completely immuned varieties is small indeed; happily others are heterogeneous in their reaction and further selection and screening may enlarge the number of resistant lines.

Another significant step has been the initiation of routine health testing for rice seed from the multiplication schemes. Apart from determining which seed lots to reject and which to grow on, this has revealed the comparative urgency of breeding for *Helminthosporium* resistance in upland rice as well as *Pyricularia* resistance in swamp rice.

Crop nutrition

A favourable environment for crop growth is a primary factor in the full realisation of the potential of improved crop material. A considerable amount of research has been carried out in this field and 1964 saw the successful conclusion of some phases of the work both in the laboratory and in the field. Recommendations (*see* Appendix IV) were made for rates and times of fertilizer application to swamp rice and for spacing and seed rate of both swamp and upland rice. The work has continued, both to extend the areas of application of recommendations already made and to make more detailed recommendations which will result in greater efficiency in the use of farmer's investments in expensive fertilizers. Sometimes such work demonstrates the limited yield potential of existing crop material as in the case of the upland rice variety Agbede 16 which is incapable of an efficient response to solar energy, and thus to applied fertilizers, at the close spacings which have increased yield/acre in swamp varieties.

Conclusive evidence has been obtained on the date of planting, field populations and type, rate and time of application of fertilizer to maize. Yields of over 4,000 lbs per acre have been obtained from the improved variety NS-1 by near optimum combinations of these factors in the rain forest zone. Similarly studies on length of storage, stand population, method of planting and field population of cassava cuttings have demonstrated combinations of establishment technique which will go a long way to maximise yield in the newly improved selections of this important crop and parallel studies on yam culture have also have significant results which, when confirmed, will be of direct value to the farmer.

Conclusion

It should however, be borne in mind by the reader that all this research, the recommendations arising from it and the efforts of the Extension Services in educating the farmer will only result in an increase in productivity if the farmer is assured the financial and social incentives to produce a saleable surplus of food. Whether such an assurance is given depends, greatly, upon the reader's evaluation of the role of the farming community.

G. E. O. Okiy,
Director of Agricultural Research

MAIZE AGRONOMY

Fertilizer studies

Studies of yield response to applications of nitrogen (as sulphate of ammonia), phosphorus (as single superphosphate) and potassium (as sulphate of potash) were continued in an experiment replicated at Ibadan, in the rain forest zone, and at Ilora in the derived savannah zone. The Ibadan trial was sited in a field which had previously been under fallow for three years and the Ilora trial on land which has been under continuous cropping. The variety used in these experiments was the recommended variety, NS-1. The whole of the superphosphate and half of the sulphate of ammonia used were applied, two weeks after planting, in small doses in close proximity to the plants. The remaining sulphate of ammonia was similarly applied a week before tasseling.

The application of 40 lbs per acre of nitrogen resulted in significant increases in yield at Ibadan, where the control yield of 3376 lbs per acre was increased by 676 lbs per acre and at Ilora where the control yield of 1710 lbs per acre was increased by 889 lbs per acre. There were further non-significant increases of 313 and 366 lbs per acre of dry grain at Ibadan and Ilora respectively, with additional applications of 40 lbs per acre of nitrogen.

The application of 20 lbs of phosphorus at Ilora resulted in a significant increase in yield of 426 lbs per acre. Additional application of 20 lbs of phosphorus at Ilora appeared to depress the yield. There was neither response to phosphorus at Ibadan nor to potassium at either station. None of the inter-actions approached significance at any of the locations.

Previous fertilizer trials at Ibadan had always shown that phosphorus applications were necessary for a good yield of maize. The lack of response of maize to phosphorus in the 1964 trials might be attributed to the accumulation of adequate amounts of phosphorus in the soil during the three years the field has been under fallow.

Apart from the lack of response to phosphorus at Ibadan in 1964, the results of the 1964 trials at Ibadan and Ilora were essentially similar to those of the previous years.

Plant population studies

These experiments, which were begun in 1963, were continued at Ibadan and Ilora during the early season of 1964.

Yields of five plant populations (9,600, 11,600, 14,500, 17,400 and 29,000 plants per acre) and two stand populations (one plant per hill planted at a given space and two plants per hill planted at double the corresponding given space) were compared at both locations. The test variety was NS-1.

The results of the experiments are summarized in Table 1.

The results indicate no significant differences in yields from the five plant populations at either station. There were also no significant differences in yields between plants planted either one or two to a hill at any one plant population. Experience has however shown that closer spacing involves more operational costs (weeding, fertilizing, harvesting, etc.) than when plants are more widely spaced. If the yields obtained from ten inch spacing are the same as those obtained from twenty inch spacing, then it is more economical to plant at the wider spacing.

Table 1—Yields of Maize Variety NS-1 at Five Field and Two Stand Populations at Ibadan and Ilora

Plant Population	*Stand Population*	Ibadan	Ilora
		Yield (lb/acre)	*Yield (lb/acre)*
29,000	1	3171	3597
	2	3346	3773
17,400	1	3184	3804
	2	3168	3842
14,500	1	3169	4020
	2	3110	3466
11,600	1	3239	3076
	2	3284	3491
9,600	1	3132	2873
	2	3198	3508
L.S.D.	—	NS	NS

Date of planting studies

Because of the extended rainy season in the rain forest zone of Southern Nigeria, a date-of-planting experiment was carried out at Ibadan in 1964 to determine the most satisfactory period of planting for dry grain production of maize.

Maize variety NS-1 was planted at weekly intervals starting from April 11 and ending September 26. Results of the trial including monthly averages for available rainfall, grain moisture at harvest, percentage plant stand at harvest and yield are shown in the Table II.

There was a significant and positive correlation ($r = +0.799$) between the yields and the number of plants at harvest. The low yields obtained from the June, July and August plantings were in part due to poor seed germination and in part to higher populations of field pests which contributed to low plant populations at harvest.

Highest yields were obtained from the April plantings. Maize planted in early May was still satisfactory from a yield stand point but thereafter there was a progressive decrease in yield till about the last week in June. Slight increases in yield over the June, July and early August plantings were obtained from plantings made in early September, that is during the late maize growing season.

Maize planted in June and July appeared to receive adequate rainfall and the low yields obtained from maize planted during this period could not be attributed to insufficient precipitation.

Table II—Monthly Averages of the Available Rainfall, stand Population, Moisture content and Yield of the Maize Variety NS-1 at Ibadan

Planting Date	Rainfall* (ins.)	Plant stand (%)	Moisture in Grain (%)†	Yield (lb/acre)
April	17.1	90	33.5	4141
May	19.5	88	31.4	2025
June	13.5	42	33.4	750
July	10.4	53	33.9	1081
August	9.7	50	32.0	1110
September	8.3	70	27.4	1525

* Total rainfall from planting to 74 days after.

† Moisture in grain 111 days after planting.

The percentages of moisture in the grain at harvest did not indicate that the different dates of planting influenced maturity in this experiment.

National maize yield trials

The objective of the national yield trials is to determine the best adapted and highest yielding varieties for each major area of production. After the completion of the first phase—1960 to 1963—of the national maize yield trials, the varieties NS-1 and Eafro 231 were widely recommended. In 1964, a new series of varieties, namely, H 503, H 507, Diacol V 153, Eafro 235, VI Ex-W/R, NS-4 and NS-5 were entered for the first time in a trial replecated at 40 locations in the country.

Excellent yields of over 4,000 lbs dry grain per acre were obtained from each of the varieties H 503, H 507 and Diacol V 153 at Jema'a and Lowlands in the North and at Ilora in the West. Satisfactory yields of 3,000 lbs or more per acre were obtained from most of these varieties at Ilele, Akure, Ibadan, Hong, Kwali and Zaria. Average yields of about 2,000 lbs per acre were obtained at most of the other locations.

There were no significant differences in yield between NS-1, the currently recommended variety, and H 503, H 507 and Diacol V 153 at most of the locations where the average yield did not exceed 2,000 lbs per acre. But the varieties H 503 and H 507 have, however, significantly out-yielded NS-1 at Jema'a, Ilora and Akure where good yields (3,000-4,000 lbs/acre) were obtained. It has been confirmed from the earlier trials that the variety, NS-1, gives good average yields under wider range of environmental conditions but has a lower yielding capacity than some of the current series of varieties when grown under any favourable conditions.

It is encouraging to note that the average maize yield at some of the Government research stations has risen steadily over the past three years. These increases are due in part to the introduction of better yielding varieties and, in part to better cultural practices.

Detailed results of the national yield trials are published annually as Departmental memoranda.

Flour content of the new maize varieties

To determine the flour yield per acre of the ten varieties which were entered in the new series of national maize yield trials, five pounds weight of the dry grain of each of the varieties Eafro 231, H 503, H 507, VI W/R, Diacol V 153, Eafro 235, NS-1, NS-4, NS-5 and Lagos White were wet milled. The "chaff", which largely consisted of pericarp, was removed with a sieve of 30-inch mesh, the size commonly used in the preparation of "eko". The sieved flour from each of the varieties was dried in the oven, weighed and the weight corrected to 14 per cent moisture content. The percentage of flour in each of the varieties was calculated.

Table III gives the average yield of dry grain per acre of the ten maize varieties entered in the yield trials carried out at Ibadan and Ilora in 1964, the calculated percentage flour content of each the varieties and the flour yield per acre.

TABLE III—GRAIN AND FLOUR YIELDS OF TEN MAIZE VARIETIES

Variety	*Grain yield (lb/acre)*	*Flour in the grain (%)*	*Flour yield (lb/acre)*
Eafro 231	3800	79.6	3025
H 503	3631	82.6	2999
H 507	3615	82.6	2986
VI W/R	3604	82.6	2977
Diacol V 153	3258	88.4	2880
NS-5	3025	85.4	2583
Eafro 235	3208	79.6	2554
NS-1	3239	76.8	2488
NS-4	2682	85.4	2290
Lagos White	2407	84.6	2036

The result indicates that Lagos White, commonly known to have a high proportion of flour per given weight, gave the lowest weight of flour per acre. This was so because of the comparatively low yield of Lagos White. The continuing choice of Lagos White over the other varieties for the preparation of "eko" must therefore be based on its superior acceptability rather than on its ability to yield a larger quantity of flour per acre.

It has however, previously been shown that there is little to choose in taste between "eko" made with either Lagos White or Eafro 231. Eafro 231, in this experiment, gave 49 per cent more flour per acre than Lagos White. If the farmer were made aware that he could obtain as

much as 49 per cent more flour per acre from Eafro 231 than from Lagos White, he would almost certainly prefer to grow Eafro 231.

Sweet corn acceptability test

Tests were carried out on four sweet corn varieties (Pajimaca, Senecca War-path, U.S.D.A-34 and Maize Dulce) and a flint but sweet type, NS-1, to determine their acceptability when boiled and eaten in the fresh state as "corn on the cob". The varieties were tasted by fifteen adult males of various ages. Eleven of the tasters preferred NS-1 to other varieties; three chose U.S.D.A-34 and only one selected Maize Dulce.

The result indicates that the true sweet corn varieties, though sweeter than NS-1, did not possess many of the essential attributes of an ideal fresh maize, such as thin pericarp, high percentage of starch and aroma. Most of the sweet corn varieties were said to be 'too sugary' and not suitable for snacks. Other recent introductions are now being tested at Ibadan.

Popcorn acceptability tests

Two varieties of popcorn, Yellow Pearl and Reventador which were introduced from the U.S.A. and Mexico respectively, have been grown and compared with a local variety—Bida Local—for yield and other qualities in the past three years.

Bida Local, averaging about 2,000 lb/acre, has yielded as well as Yellow Pearl. But tests carried out in the laboratory have indicated beyond question that Yellow Pearl has excellent popping ability and is superior in other respects to Bida Local. Reventador, on the other hand, is a low yielder and does not pop as well as Yellow Pearl. Seeds of Yellow Pearl are now being multiplied for immediate release to the farmers.

CASSAVA AGRONOMY

The effect of storage on the yield of cuttings

An experiment was carried out at Umudike to compare the yield of unstored cuttings with cuttings stored for 7 and 14 days before planting. The test varieties were acquisitions 53101, 44086 and 43053.

The result of the experiment is summarized in Table IV.

TABLE IV—YIELDS (TONS/ACRE) FROM CUTTINGS OF THREE CASSAVA VARIETIES, STORED FOR VARIOUS PERIODS

Variety	*Period of Storage (days)*			*Variety Mean Yield*
	0	7	14	
Acq. 53101	8.4	10.2	8.8	9.1
Acq. 44086	6.2	7.7	6.7	6.9 (L.S.D. @ 5% = 1.0)
Acq. 43083	4.2	7.7	8.3	6.7
Mean yield	6.3	8.5	7.9	—
		(L. S. D. @ 5%= 1.1)		

It would appear from the above result that storing cassava cuttings for a short period of time had some beneficial effects on yield. The acquisitions 53101 and 44086 gave the highest yields when cuttings were stored for 7 days. Thereafter there was a decline in yields amounting up to 1 ton or more per acre when the cuttings were stored for 14 days. With acquisition 43083 there was a progressive increase in yield as the storage period was increased. Further physiological studies are indicated.

Stand population versus method of planting studies

Two cassava varieties (Acq. 53101 and 44086) were included in a field trial conducted at Umudike to compare two methods of planting, namely, burying the cuttings horizontally about 3 inches below the soil surface and planting obliquely leaving some portion above the surface. Stand populations of one, two and three cuttings per hill at a standard field population of 4,840 plants to the acre were used.

There was no difference in yield between stand populations of two and three cuttings on hill (7.4 tons/acre each) but these stand populations gave significantly higher yields than one cutting per hill (5.6 tons/acre) for each of the two methods of planting used. The results further shows that oblique planting gave significantly higher yield (7.5 tons/acre) than burying (6.8 tons/acre).

On the basis of this result and similar ones obtained in 1961, it has been clearly shown that planting two or three cuttings per stand ensures a higher yield than planting one cutting per stand.

Spacing studies

An experiment to determine the yields of six cassava varieties — acquisitions 62823, 62786, 62745, 62624, 62750, 62833—at various ridge widths (3, 4 and 6 feet) was carried out in 1964 at Umudike. A constant feeding area of 12 sq. ft/stand was obtained by varying the spacings along the ridge.

The highest yields from all six varieties were obtained from the 4 feet ridges and the lowest from the 6 feet ridges. It was also noted that all six varieties used in the experiment—which included three growth forms, namely, low branched, medium branched and high branched—showed better vegetative growth on the 4 feet ridges than on others.

YAM AGRONOMY

Sett weight studies

Previous experiments have shown that larger sett weights gave higher yields than smaller sett weights. In the light of these results, an experiment was carried out in 1963 and repeated in 1964 at Umudike to determine whether these differences in yields could be attributed to the size of the parent yam tuber.

Parent tubers weighing less than 2.5 lbs, above 2.5 lb but less than 3.5 lbs, and above 3.5 lbs were all cut into setts of 12 oz weight.

Result indicate that 12 oz setts obtained from parent tubers weighing less than 2.5 lb gave the highest yield (6.9 tons/ acre), followed by setts obtained from parent tubers weighing not more 3.5 lbs (6.8 tons/acre). There was, however, no significant difference in the yields produced by these two categories of sett but both significantly out yielded the setts cut from parent

tubers weighing over 3.5 lbs. These only yielded 5.7 tons/acre. This result was essentially similar to that obtained in 1963. In both years, better yields were obtained from 12 oz setts cut from smaller parent tubers. It was also observed that setts from smaller parent tubers gave better germination than setts from larger parent tubers. It is therefore recommended to plant yam setts obtained from small tubers when both big and small tubers are equally available.

Spacing studies

One of the primary objectives of the yam agronomy programme is to increase yam production per unit feeding area without reducing the percentage yield of 'ware' tubers per acre. Apart from seed weight, tuber weight, and sett weight, two other determining factors are ridge width and the spacing on the ridge. Preliminary investigations begun at Ibadan in 1960 were not conclusive. A more comprehensive experiment was initiated at Umudike in 1964 in which unit feeding areas of 6, 9, 12 and 15 sq. ft. on 3, 4 and 6 foot ridges were compared. See Table V.

TABLE V—YIELDS OF YAM TUBERS (TONS/ACRE) AT DIFFERENT FEEDING AREAS AND RIDGE WIDTHS

Ridge width	*Unit feeding area*				*Mean yield, ridge widths*
	6 *sq. ft.*	9 *sq. ft.*	12 *sq. ft.*	15 *sq. ft.*	
3 ft.	9.3	7.6	6.3	4.6	7.0
4 ft.	8.9	6.3	5.6	5.5	6.6 N.S.
6 ft.	9.8	7.0	6.5	4.9	7.1
Mean yield, unit feeding area	9.3	7.0	6.2	5.0	—

(L. S. D. @ 5% =0.6 ton/acre)

The best yields, regardless of ridge width, were obtained from a unit feeding area of six sq. ft. There was a progressive decrease in yield in acre as the feeding areas increased. It was, however, observed that the average weight per tuber increased as the feeding areas increased. There was no significant difference in yield between the three ridge widths.

Staking studies

Results of previous experiments have conclusively shown that the yields of *D. alata* and *D. cayenensis* are decreased by 35 to 66 per cent if staking is not carried out whilst the yield of *D. rotundata* is increased by about 50 per cent when they are staked.

In order to find if there was any differential effect on the yield increment due different staking heights, experiments were carried out with *D. rotundata*, using 2, 4 and 7 ft. stakes at Umudike, Benin and Ibadan in 1963 and 1964.

The 1963 trials showed that there were invariably significantly greater increases in yield as the staking heights were increased. The 1964 results showed no such differences but the best, though not significant, increase in yield was, however, obtained when 7 ft. stakes were used. These results are not yet conclusive and more experiments are to be conducted with various varieties of yam at more locations before definite conclusions can be drawn.

Mulching studies

Conflicting opinions on the importance of and need for mulching yams particularly in Southern Nigeria, have been expressed by several research workers. Because of the lack of conclusive data, a further experiment was conducted at Umudike in 1964 to investigate the effect of mulching on the germination and yield of *D. rotundata.* Ridge widths of 3, 4 and 6 ft. were also compared in this investigation.

The result showed that mulching did not apparently affect germination but it did increase yield by 30 per cent. Statistical analysis showed that there was no significant interaction between ridge width and the mulching treatment.

SWEET POTATO AGRONOMY

Fertilizer studies

Fertilizer experiments to determine the responses of sweet potatoes to calcium, nitrogen, phosphorus and potassium were conducted at the Umudike Experiment Station in 1964. These fertilizers were applied at two levels namely zero and 100 lbs of Ca, 56 lbs N, 90 lbs $P_2 0_5$ and 93 lbs $K_2 0$ per acre, in all the possible combinations.

Results showed that sweet potatoes did not respond to potassium when applied alone, though in combination with lime, the yields increased appreciably. Neither nitrogen nor phosphorus when applied alone or in combination increased yield. There was, however, a positive and significant interaction when nitrogen, phosphorus, potassium and calcium were applied in combination. These results agree with those obtained from similar experiment conducted at the same station in 1963.

Time of planting and harvesting studies

In order to determine the most suitable period of planting and harvesting for sweet potatoes, an experiment was conducted at Umudike Experiment Station in 1964. Three planting dates (May, June and July) and four maturation periods (120, 140, 160 and 180 days from planting) were used.

Statistical analysis indicated that there was no significant difference in yield between May and June plantings but the yield obtained from the June planting was significantly superior to the yield obtained from the July planting. The best establishment of 93 per cent was also obtained from the June planting as compared with 53 and 45 per cent obtained from the May and July plantings respectively.

Harvesting results indicated that a maturation period of 180 days gave the highest yield followed by 160 and 140 days. It was, however, observed that the incidence of tuber cracking and weevil attack was directly related to length of the maturation period.

Spacing Studies

A preliminary investigation to determine the optimum spacing of sweet potatoes was initiated at Umudike during the year. Potato cuttings were planted at 9″, 12″ and 15″ spacings on 4 ft. ridges.

The results showed no significant differences in yield between the spacings though the 9″ spacing gave the highest yield of 7.5 tons per acre, compared with yields of 7.0 and 6.7 tons obtained from 15″ and 12″ spacings respectively. The experiment will be repeated in 1965.

EVAPOTRANSPIRATION

Evapotranspirometers, based on the Garnier model as described in the previous reports, have been used to determine the potential evapotranspiration of upland rice during the early season and of groundnuts during the late season of 1964.

Rice

The rice was planted on April 13 and harvested on August 8th, 1964, thus occupying a growing period 119 days. The variety used was Agbede 16/56 and the spacing 12″ x 9″. Seven plots consisting of two planted and mulched, two planted and unmulched, one unplanted and mulched, one unplanted and unmulched and a control plot which was planted to bahama grass, were used. The total amounts of water lost during the growing period by evapotranspiration from the soil kept at field capacity were as follows:—

Rice, mulched	967.9 mm = 38.1 inches
Rice, unmulched	1154.9 mm = 45.5 inches
Unplanted, mulched	243.5 mm = 9.6 inches
Unplanted, unmulched	438.2 mm = 17.3 inches
Bahama grass	418.0 mm = 16.5 inches.

It is clear from the figures that the potential evapotranspiration of rice was much higher than that of bahama-grass. Mulching considerably reduced the evaporation from the unplanted soil. In the rice plots this was only so during the early stages of growth. As soon as the crop formed a complete canopy, the differences between mulched and unmulched plots disappeared as in shown in Table VI.

Table VI—Daily Evapotranspiration of Mulched and Unmulched Rice

Month	*Evaportranspiration (mm)*	
	Mulched	*Unmulched*
April	1.5	4.3
May	6.3	8.9
June	11.8	13.6
July	10.8	10.6
August	6.3	7.2

Although initially the vegetative growth of the rice was better on the mulched plots, the variety used did not benefit from the rapid early growth and subseqently the yield was not significantly different for both mulched (1120 lbs.) and unmulched plots (1230 lbs/acre).

Groundnuts

After the rice had been harvested, groundnuts were planted on August 27, 1964 and harvested on January 4, 1965, thus occupying a growing period of 131 days. The mulch treatments were the same as with the rice.

The following data represent the total amount of water lost by evapotranspiration during the growing period :—

Groundnuts, mulched	534.7 mm = 21.1 inches
Groundnuts, unmulched	660.3 mm = 26.0 inches
Unplanted, mulched	158.2 mm = 6.2 inches
Unplanted, unmulched	463.0 mm = 18.2 inches
Bahama-grass	426.3 mm = 16.8 inches.

From the above it was again observed that mulching depressed evaporation. The effect was again smaller on the planted plots than on the unplanted plots. This is explained by the fact that the plants on the mulched plots grew more luxuriantly than those on the unmulched plots, and, therefore, extra water was lost by transpiration.

The differences in growth between the mulched and unmulched plots of groundnuts at various stages of plant development can be seen in Table VII.

TABLE VII—MEASUREMENTS OF PLANT GROWTH OF GROUNDNUTS AT VARIOUS STAGES OF DEVELOPMENT

	Dates of Measurement					
	28/9/64	12/10/64	30/10/64	16/11/64	30/11/64	15/12/64
Mulched : height	11.4 cm.	16.0 cm.	21.3 cm.	26.7 cm.	29.2 cm.	27.4 cm.
Mulched : coverage	18.7	28.3	42.2	52.0	59.4	58.1
Unmulched : height	5.3	7.1	12.2	16.0	19.3	19.1
Unmulched : coverage	12.1	16.6	23.1	28.1	35.7	39.7

Since the plants were planted in rows 60 cm. apart it is clear that the plants on the mulched plots covered the field almost completely by the middle of November whereas the plants in the unmulched plots covered only two thirds of the field by the middle of December.

Yields obtained from mulched plots (744 lbs/acre) were also significantly superior to those (428 lbs/acre) from the unmulched plots.

Grass

The average daily potential evapotranspiration for the standard plots, planted with bahama-grass was as follows :—

January	1964	3.2 mm	September	1964	2.6 mm
February	,,	5.4 mm	October	,,	3.2 mm
March	,,	5.2 mm	November	,,	3.9 mm
April	,,	4.6 mm	December	,,	3.4 mm
May	,,	4.2 mm	January	1965	3.0 mm
June	,,	4.3 mm	February	,,	4.0 mm
July	,,	2.4 mm	March	,,	4.7 mm
August	,,	2.5 mm			

It is obvious that the potential evapotranspiration was cyclical with the highest figures for the hot and dry months of the dry season (February, March), and with the lowest figures for the cool and cloudy months of the short dry season (July, August and part of September).

MAIZE BREEDING

High rainfall areas programme

Production of inbred lines.—The production of inbred lines from promising and acceptable open-pollinated varieties is the first phase of any programme for breeding high yielding synthetic varieties possessing desirable grain characteristics and adapted to wider range of environment.

Three hundred and forty-eight S_3 and S_4 inbred lines of two dent varieties (Sicaragua, Eafro 231) and four local floury varieties (Lagos White, Bende White, Bende Local, Ugep White) were produced in the early and late season. Eafro 231 and Lagos White were very poor in growth in the late season and only a limited number of ears could be selfed and selected.

Trials of inter-varietal crosses.—In order to find out the best combining dent and floury varieties for the development of multivarietal synthetics 18 inter-varietal crosses between six floury varieties (Lagos White, Bende White, Bende Local, Ikom White, Akwete White, Ugep White) and two dent varieties (Eafro 231, Diacol V. 153) as well as the floury variety (Lagos White) were produced in the 1963 late season. Co-operative yield trials of these intervarietal crosses and their three male parents were conducted at Ibadan, Ilora and Ilaro in the 1964 early season.

Grain yields ranged from 1940 to 2907 lbs per acre for intervarietal crosses and from 1714 to 2582 lbs per acre for male parents at Ilora ; at Ilaro yields ranged from 2520 to 3623 lbs per acre for intervarietal crosses and from 2588 to 3203 lbs per acre for male parents. However, owing to very high co-efficients of variability, differences did not reach statistically significant levels at either location. Eafro 231 and Diacol V. 153 gave grain yields of 4339 and 3229 lbs per acre respectively at Ibadan and were significantly superior to Lagos White (2515 lbs per acre). However, none of the intervarietal crosses involving these two pollinators exceeded them in yield and two crosses (Bende White x Eafro 231, Akwete White x Diacol V. 153) showed an appreciable reduction. The inter-varietal crosses of Ugep White, Akwete White and Ikom White with Lagos White gave significantly higher yields (3897 to 4339 lbs per acre) than Lagos White.

A further series of inter-varietal crosses involving the same six floury varieties mentioned earlier and a dent variety, Sicaragua, were produced in the 1964 early season and were tested at Ibadan in the late season along with the 18 earlier crosses. The performance of the inter-varietal crosses and their parents in the late season was at variance with that in the early season. Eafro 231, Diacol V. 153 and Sicaragua (775 to 1013 lbs per acre) were significantly outyielded by Lagos White (1542 lbs per acre). Although none of the inter-varietal crosses gave a significantly higher grain yield than Lagos White, the yields obtained from crosses of Akwete White and Lagos White with Sicaragua were a promising 300 lb/acre greater than the yield of Lagos White.

Evidence as to the best varietal combinations for the production of synthetic varieties or hybrids is so far inconclusive.

Trials of top crosses.—Twenty five S_4 inbred line of Mexico 5, Sicaragua, Eafro 231, Lagos White, Akwete White and Ikom White top-crossed with Lagos White and Eafro 231 were tested at Ibadan and Ilaro in the early season. The object of these top cross tested is to select the best combining inbred lines to make up new synthetic varieties. Owing to the limited number of replicates and a high co-efficient of variation, differences between top-crosses did not achieve significance at either site in 1964.

Establishment of a blight resistant population.—Nineteen S_3 inbred lines of ten West African varieties which have shown some resistance to Southern leaf blight (*Helminthosporium maydis*) were bulked in 1963. The bulked material was grown in an isolation plot in 1964 and allowed to interpollinate in order to concentrate blight-resistant germplasm in desirable plants.

Maize survey in Eastern Nigeria.—A survey of Eastern Nigeria to establish the relative importance of fresh maize and dry grain in the diet of the people was completed. Fresh maize was found to be equally as important as dry grain and there is a need in the region for a maize variety suitable for consumption on the cob. Such a variety should have a desirable flavour and high food value.

Maize breeding for medium rainfall areas

The programme to produce new synthetic varieties adapted to conditions in the riveraine Provinces of Northern Nigeria has now gone through the first phase. It consisted of selecting and selfing well-adapted plants in nineteen local varieties at Mokwa, Northern Region, in the early season and growing them in Ibadan during the late season for sibmating. With the completion of two cycles, the selected material is now ready for the production of top-crosses with tester varieties (Lagos White, Eafro 231, Sicaragua) and for yield comparisons.

GRAIN LEGUME BREEDING

The Nigerian Grain Legume Gene Bank

The bulk of the work on grain legumes was transferred from Ibadan to Samaru, Northern Nigeria, in April 1964 with the establishment of the Nigerian Grain Legume Gene Bank at the Institute for Agricultural Research. The objectives of the 'Gene Bank', which is an arm of the Botany Division, include the collection and maintainance of the germplasm of all indigenous and exotic edible grain legumes, with particular emphasis on cowpeas (*V. sinensis*) so as to prevent loss of potentially valuable genetic material ; fundamental botanical and cytogenetical studies on cowpeas, the introduction of grain legume species of economic importance from other countries and the distribution of seed and dissemination of information on grain legumes to other research workers.

Legume Collection.—In addition to the acquisitions transferred to Samaru from Ibadan the Gene Bank's collection was augmented by the material previously collected in Northern Nigeria by Dr W. R. Stanton. After the elimination of duplicate acquisitions, some 936 cultivars were sown for observation in the field. These included 483 cultivars of cowpea, and lesser collections of soya bean, sword bean, green and black gram, Lima bean, yam bean, guar, Bambara groundnut, kidney bean, Tepary bean and hyacinth bean.

The four hundred and eighty three cowpea cultivars were found to be mixtures of many seed colours and were separated at harvest on the basis of seed coat colour, seed eye colour, seed coat texture seed shape or a combination of these characters.

Botanical Studies.—The main object was to differentiate morphologically and cytogenetically between the cowpea types so far assembled in the Nigerian Grain Legume Gene Bank with a view to establishing a stable and workable classification of the species. This also involved the study of other characters of economic importance such as resistance of the cultivars to insect pests and diseases. Over forty important plant characters of 483 cowpea cultivars were recorded during 1964 in the preliminary survey of the collection.

Cowpea breeding.—The variety trials of twenty-five day-neutral and twenty-five short-day cowpea varieties were carried out at Samaru in 1964. Correlations between yield and yield components in day-neutral and short-day cowpea varieties were studied.

Day-neutral cowpea varieties were planted on the 16th June. Two American introductions Dixie-Lee-Queen and Brown Crowder, a South African introduction, New Era, and a Mauritius variety (Acq. No. 152) gave promising yields when compared to the best Nigerian variety (Jaba Mwoi). Short-day cowpea varieties were planted on the 13th August. The range of estimated yields was narrower (1089 to 1996 lb/acre) in this trial than in day-neutral variety trial (998 to 2904 lb/acre) and the highest yields were given by Nigerian short-day varieties.

Yield components of each cowpea variety in the two trials were recorded in terms of number of pods per plant (X) number seeds per pod (Y) weight of 100 seeds (Z) and yield per plant (W). Direct correlations between these characters are given in Table VIII.

TABLE VIII—DIRECT CORRELATIONS BETWEEN YIELD AND YIELD COMPONENTS

Characters	*Correlation Coefficients (r)*	
	Day-neutral varieties	*Short-day varieties*
X W	+ 0.70 **	+ 0.60 **
Y W	+ 0.30 *	+ 0.60 **
Z W	+ 0.30 *	+ 0.50 **
X Z	− 0.40 **	− 0.20
Y Z	− 0.30 *	− 0.40 *
X Y	− 0.20	− 0.10

Significant Correlations = * (P = 0.05) ** (P = 0.01)

High plant yields were significantly associated with higher number of pods per plant and higher number of seeds per pod, and with heavier seeds, though, in the day-neutral variety trial, a higher number of pods per plant had greater effect on yield than the other characters. There was no significant relationship between number of pods per plant and number of seeds per pod in either trial but both components showed a significant negative association with mean seed weight in the day-neutral trial. Number of pods per plant also had a significant negative relationship with mean seed weight in the short-day trial.

It therefore appears that yield can be improved by selection for a higher number of pods per plant and seeds per pod within a narrow range of mean seed weights. The extent of variation between selected plants of the varieties in the two trials is shown in Table IX.

TABLE IX—RANGE OF VARIATION IN YIELD AND YIELD COMPONENTS IN TWO VARIETY TRIALS

Character	*Day-neutral varieties*		*Short-day varieties*	
	Range	*C.V* (%)	*Range*	*C.V* (%)
No. of pods/plant	18.0 - 51.9	10.0	19.8 - 48.2	19.8
No. of seeds/pod	13.0 - 16.9	3.0	10.3 - 15.1	8.9
Weight of 100 seeds (oz.) ..	0.27 - 0.60	7.8	0.28 - 0.64	30.4
Yield/plant (oz.)	1.1 - 3.2	16.8	1.2 - 2.2	26.0

CASSAVA BREEDING

The improvement programme for cassava was continued with emphasis on the testing of selected high yielding hybrids and varieties at various centres in the Federation and collecting of local varieties for assessment of their yields and qualities. Hybridization was temporarily suspended in order to assess thoroughly the numerous hybrid materials now available.

National cassava collection

Further progress was made towards the construction of a key to the classification of the existing national collection of over 500 varieties of cassava maintained at Umudike. It became evident however that some of the characters under consideration varied both with the age of the plant and the season of the year.

A further 251 local varieties from Abak, Nekede, Osara, Akure, Oyo and Ibadan were acquired for the national collection during the year.

Regional variety trials

Cassava variety trials were conducted in 1963-64 at Abak, Nekede and Abakaliki in the East ; Iyanomo in Mid-West ; Akure, Ilora, Ibadan and Agege in the West ; and Yandev, Osa ra, Ilorin, Mokwa and Samaru in the North. The co-operation received from the staff of the Regional Ministries of Agriculture at all the trial sites contributed greatly to the success of the year's programme.

Eastern Region.—The results showed that hybrid 60506 was the highest yielder in all the trials at the three trial stations, and for the second year in succession 60506, 60447 and 53101 significantly out-yielded the local varieties in these trials.

The average yield for 60506 at the three stations was 7.1 tons/acre compared with 5.5 tons/acre for 53101, 4.2 tons/acre for the local varieties and an overall average yield of 4.9 tons/acre from the twenty-one varieties in trial at these centres. The lowest yields were obtained from Abakaliki.

Twenty-four local varieties from the Eastern Region were tested against the recommended variety 53101 at Umudike. Two varieties, namely Ogbumaramara ex Etche and Okon Ekombe, yielded significantly higher than 53101 at 1% and at 5% levels respectively.

Western Region.—The results of the 1963-64 trials at Agege, Ibadan, Ilora and Akure showed that hybrid 60447 was the first at all the four centres and that it gave a significantly higher yield than 53101 at all the centres except at Ilora. It also yielded significantly better than the local varieties Oniyide Fun Fun, Oke Okun and Olesun. The average yield of 60447 at the Western Region trial sites was 12.9 tons/acre and that of 53101 was 10.0 tons/acre. The overall average yield of the twenty-three varieties in trial was 9.2 tons/acre.

Mid-Western Region.—There was no significant difference between the yield of the two hybrids 60444 and 60438 and the variety 53101 (8.1 tons/acre) at N.I.F.O.R., Benin. These varieties do not do so well as some local varieties in the high rainfall of the Mid-West. Thus, the replicated collection of local varieties and hybrids at Kwali Agricultural Station showed that local varieties Everhe, Ughovwe and Ekole were the highest yielders. These will be included in a new trial for Mid-Western station for 1964-65.

Northern Region.—Although variety 53101 gave consistently high yields in the 1963-64 trials conducted at Mokwa, Ilorin, Osara and Yandev, it yielded significantly lower than 63104 at Mokwa and 60520 at Osara. The average yield of 53101 was 5.5 tons/acre as against the average yield of 4.6 tons/acre from all the thirty varieties tested.

In the trial of local 'sweet' varieties at Samaru, varieties Duasi, from Yandev, Dan Warri from Zonkwa and a local variety from Ilorin yielded significantly higher than the rest of the varieties, including the original strain of Dan Warri from Samaru. Duasi yielded 8.5 tons/acre and the average yield for the station was 5.2 tons/acre. In second trial at Samaru, including hybrids and introduced varieties, there was no significant difference between the yield of Dan Warri from Samaru, hybrids 60480 and 60447, and the sweet varieties Ifam Iwa and Jiakpu Oji from the East.

Progeny selections

A review of three years yield data (1961-63) on selections from the 1956 and 1957 series of hybrids has indicated that only selections 60447 and 60506 from cross 42074 x 53101 and selections 60444 and 60509 from cross 32031 x 53101 are likely to give higher tuber yield than the standard variety 53101. Quality tests on these selections are being carried out.

Dry matter tests

At Umudike 332 varieties in the 1963-64 National collection were tested for the dry matter content of tubers. There was tendency for the percentage dry matter content to decrease from heads to bottoms. Varieties 58306, 61539 and 62608 gave the highest dry matter content of 49 per cent each.

YAM BREEDING

National yam collection

The national collection, again grown for observation of the characteristics to be used in a provisional classification of Nigerian yam varieties, included 292 varieties of yams from ten species of *Dioscorea* including :

D. rotundata (165), *D. cayanensis* (24),
D. alata (31), *D. dumetorum* (37), *D. bulbifera* (26),
D. quartiniana (5), *D. macroura* (1), *D. floribunda* (1),
D. composita (1), *and D. esculenta* (1).

A draft provisional key to the Nigerian varieties of *Dioscorea spp.* was submitted for publication at the end of the year.

Regional variety trials

Variety trials with white yam, *Dioscorea rotundata*, and yellow yam, *D. cayanensis*, were carried out in the Regions. Trial sites included Mokwa, Osara and Yandev in the North, Ibadan in the West and Umudike in the East.

Eastern Nigeria.—The variety Bakin doya from Keffi gave the highest yield of 9.0 tons/acre in the 1964 repeat of a trial comparing eight white yam varieties at Umudike and its yield was significantly higher than five other varieties including Ji-Okom from Owerri, which was the highest yielder in 1963. The average yield of varieties was 6.3 tons/acre.

In the repeated trial of six yellow yam varieties at Umudike, variety Egbenehikuere from Benin, gave the highest yield of 6.7 tons/acre and was significantly superior to all the others except local variety 396.

Western Nigeria.—The highest yielder of twelve local white yam varieties compared for a second year at Moor Plantation was the variety Ibadan local (8.8 tons/acre) which was significantly superior to seven other varieties in the trial. The average yield from the experiment was 6.0 tons/acre.

Yields were low (average = 3.6 tons/acre) in the eight varieties of yellow yams also tested for a second year at Moor Plantation Ibadan. The highest yielding variety was, again, Igangan from Ilora which gave 5.1 tons/acre which was significantly better than the yields of all the other varieties except Elegboro from Ogbomosho.

Mid-Western Nigeria.—At Iyanomo, near Benin, the yields of yams were generally low in 1964. Significant yield differences were not obtained in either the trial of five local varieties of white yam or in the trial of three varieties of yellow yam. The highest yields of 3.6 and 3.7 tons/acre were given by white variety Arebu and yellow variety Egbenehikuere respectively.

Northern Nigeria (*Riveraine Areas*).—Variety trials of white yam were carried out at Yandev, Osara, and Mokwa in 1964. At Osara and Mokwa the varieties tested were those which had given high yields in previous trials at Osara, Kabba and Ilorin ; whereas the Yandev trial was a repeat of the varieties tested in 1963 with the addition of three local varieties.

Amongst the 13 varieties tested at Yandev, the highest yielding variety, Gwaguze (8.2 tons/acre), was significantly better than four other varieties, thus confirming the promising performance shown in 1963. The average yield of this trial was 7.0 tons/acre. Awala and Boki gave the highest yields of 7.7 tons/acre at Osara and were significantly superior to three out of the seven varieties in the trial. Again this confirmed their previous performances at Ilorin and Kabba. The average yield was 7.1 tons/acre.

Except variety Andori, which gave the highest yield of 7.7 tons/acre, all the varieties tested at Mokwa gave yields less than 3.8 tons/acre. The low yields obtained at Mokwa were attributed to poor establishment and yam beetle attack on the tubers, though Andori was very promising in 1963 at Osara.

SWEET POTATO BREEDING

Variety trials

Six varieties were tested in a yield trial at Umudike. The highest yield of 8.4 tons/acre was obtained from 2342 (a hybrid from two Fiji varieties) and it was significantly better than varieties 2291 (B5) and 2292 which gave 5.0 and 4.8 tons/acre respectively.

REPORT ON THE CHEMISTRY DIVISION

GENERAL

During the year work in this Division was directed mainly towards the determination of the status of major nutrients in soil samples taken from the various crop nutrition experiments of the Agronomy Division and the continuation of the long term experiments on maintenance of soil fertility. Efforts to calibrate the medium quartz spectrograph for the determination of trace elements in soil and plant materials continued though hampered by lack of staff. With the opening of the renovated Chemistry laboratory it was possible to increase the scope of the analyses carried out. The Chemistry laboratory at the Rice Research Station Badeggi which was closed after the departure of Dr Takahashi was re-opened with a small team of laboratory technicians to carry out the analysis of soils, rice materials and irrigation water.

SOIL AND PLANT ANALYSIS

Routine analysis for the major elements was carried out on several hundreds of soil samples taken from crop nutrition experiments both at Ibadan and at the Regional Substations. Samples from the Ministry of Agriculture and Natural Resources, Western Region and the Ago-Are Tobacco Farm were also analysed. In most of the experiments involving NPK treatments an attempt was made to assess the amounts of these elements remaining in the soil at the end of the growing season. Values for the Cation Exchange Capacity and Total Exchangeable Bases were obtained for some of these soils and proved useful guides to their major nutrient status.

The Bouyoucos method of mechanical analysis of soils was adopted in cases where a knowledge of the particle size distribution of the soil would be helpful in the assessment of the soil characteristics.

Plant analysis consisted mainly of the determination of starch, moisture and hydrogen cyanide content of cassava tubers for the Botany and Agronomy Divisions. Three methods for the determination of starch in cassava tubers namely, the specific gravity method; the percentage moisture method and the grating method, were investigated. The specific gravity method was adopted for routine analysis. Analytical results for different varieties of cassava tubers indicated a moisture content of about 60 per cent for all varieties and starch contents ranging from 22 to 31 per cent. The hydrogen cyanide content showed a much wider variation ranging from 1.7 to 5.1 mg/100 gm though the range was lower than expected. On the basis of these analytical figures, variety 53101 was selected as the best, having a starch content of 30 per cent and 1.8 mg/100 gm of hydrogen cyanide.

Spectrochemistry

Efforts were made to calibrate the medium quartz spectrograph for spark work. Emulsion characteristic curves were drawn for B10 photographic plates and the contrast factors of 1.17 1.18 and 1.19 obtained compared very well with values obtained at the Macaulay Institute.

Strontium 4077A and Lithium 3232A were tried as internal standards for magnesium 2802A but they proved to be unsuitable. Magnesium 2791A was considered with a view to selecting a close iron line as the internal standard, but the sensitivity of this magnesium line was rather low.

YAM PESTS

Biology of Heteroligus meles

Breeding migration.—It is now well established that the yam beetle has one generation a year. There are two nocturnal flight periods, during which the beetles migrate. The first flight or feeding migration usually occurs between April and June and the second flight or breeding migration usually takes place from October to December but this varies from locality to locality. In 1964 the duration of the breeding migration was studied at Bori-Ogoni, Onitsha, Agenebode, Benin and Bacita and the dates for first and last observed flights together with the number of beetles collected are given in Table X.

TABLE X—DURATION OF BREEDING MIGRATION OF HETEROLIGUS MELES

Locality	*Flight Period*		*Beetles collected*	
	First collection	*Last collection*	*H. meles*	*Prinoryctes sp.*
Ogoni	Oct. 2	Dec. 22	52	15
Onitsha	Late Sept.	Dec. 11	705	105
Agenebode	Oct. 9	Nov. 26	24	—
Benin	Oct. 2	Dec. 31	21	—
Bacita	Oct. 8	Nov. 6	18	—

Oviposition.—In the laboratory at Ibadan oviposition commenced on 24th November, 1964 whereas it was first observed at Ogoni on 30th November, at Onitsha on 27th November, at Agenebode on 16th December and at Benin during late December. The numbers of eggs produced by beetles collected from three localities, at Bori-Ogoni, Onitsha and Bacita, was also studied. It was found that both the oviposition period and the number of eggs laid by these beetles varied considerably. The data are presented in Table XI.

Table XI—Oviposition Period and Egg Production in Heteroligus Meles

	Ogoni	*Bacita*	*Onitsha*
No. of females observed	8	21	74
No. of eggs (per females)..	0.66-9.0 (3.12)	4.5-9.5 (6.9)	0.8-4.4 (2.4)
Oviposition period (in days)	10-45 (20.4)	45-62 (52.2)	36-51 (43.3)

(The figures in brackets are weighted means).

Eggs.—Freshly laid eggs weigh 0.018 to 0.25 gm and, nearer hatching time, 0.057 to 0.064 gms. In the Ibadan laboratory at room temperature (77°F) the eggs hatched in 16-21 days and the first instar lasted for 24-25 days ; the second instar lasted for 24-25 days. At a lower temperature (73°F) the first instar was rather prolonged and lasted for 25-48 days whereas the duration of the second instar was the same as that at room temperature (24-25 days).

Field population.—The larval populations in the breeding areas along the banks of River Niger near Onitsha were studied. In this area samples consisting of 18 inch cubes of soil were taken under various vegetations at various depths to study the population density and the depth at which the larvae are found. It was found that the larvae were most abundant in the first six inches of the soil and were common under Guinea grass. Only a few occurred under Elephant grass. The gut contents of the larvae indicated that the larvae fed on the grass roots. The larvae were found both in semi-dry and moist soil and the temperature of the soil at that depth was found to be 73°F plus 2°.

All the larval instars were collected during February whereas during March mostly second and third instar larvae were found. No pupa or adult was collected during this period.

SUGAR CANE PESTS

Biology of Heteronychus licas

Studies on the biology and ecology of *Heteronychus licas*, the sugar cane bettles, were continued at Bacita and Ibadan. It was found that the larval stages were common from September till late February or early March when newly emerged adults made their appearance. The adults were common in the field from March till October. During July and August the

beetles were usually found deep in the soil resting from whence they appeared again in September and fed voraciously on the sugar cane tillers and caused extensive damage. There was one generation in the year. The collection data for the period is given in Table XII.

TABLE XII—HETERONYCHUS LICAS COLLECTED FROM SUGAR CANE AT BACITA

Month	*No. of plants examined*	*No. of plants damaged*	*Percentage plant attacked*	*No. Collected*		
				Larvae	*Pupae*	*Adults*
September 1964 ..	757	400	53%	43	34	126
October	603	325	54%	72	—	98
November	296	50	17%	111	—	—
December..	450	150	33%	128	—	—
January 1965	270	72	27%	41	—	—
February	30	6	20%	3	—	—
March	564	518	76%	—	—	999

Flight Periods.—There were two definite nocturnal flight periods for the beetles during which they distributed themselves in the field. The first flight—post-teneral flight—occurred during April to July and the second flight, which was pre-reproductive, occurred during October to December. The bettles in the pre-reproductive flight were first seen flying on 8th October and the last flight was observed on 24th November, with a peak during the last week of October. During this period 196 *Heteronychus licas*, 10 *H. oryzae* and 112 *Adoretus* sps. were collected. The number collected in each month is given in Table XIII

Month	*H. licas*	*H. oryzae*	*H. meles*	*Adoretus sp.*
October	154	7	13	94
November	42	3	5	18
December	—	—	—	—

Life cycle.—In the laboratory at Ibadan egg laying was first observed on 4th November, 1964 and the eggs hatched in 9-12 days. The young larvae were fed on grass roots whereas the later instars were fed on sugar-cane. At Bacita, in the field, larvae were common from September till February, feeding both on roots of sugar-cane and wild grasses. Adults were first collected on 4th March, and were very abundant in the field.

Sugar-cane stem borers

Stem borers (*Sesamia* sp., *Eldana* sp. and *Chilotrea* sp.) attacking sugar-cane at Bacita were also studied. It was found that the larval population in the field increased from May and reached its peak during August, and then declined from November onwards. The number of sugar-cane stems found attacked in the field and the number of the several species of stem borer larvae collected per month is given in Table XIV.

TABLE XIV—STEM BORER (LARVAE) POPULATION AT BACITA

Month	*No of dead hearts examined*	*Sesamia*	*Eldana*	*Chilotrea*
March 1964	2,300	442	—	—
April 1964	4,502	170	1	15
May 1964	1,357	424	2	2
June 1964	4,363	927	36	27
July 1964	5,624	1,186	27	132
August 1964	7,311	2,182	22	187
September 1964	7,891	1,666	2	193
October 1964	5,141	1,010	10	10
November 1964	540	301	6	14
December 1964	89	6	—	—
January 1965	58	—	22	—
February	360	54	21	4

CITRUS PESTS

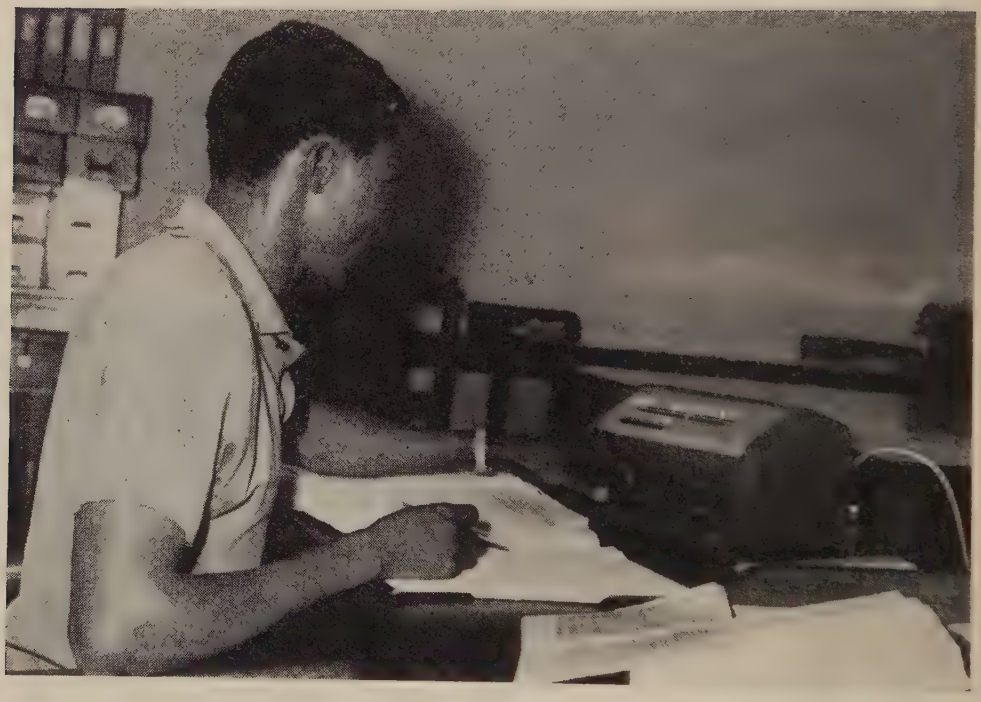
Scale insects

Host range.—In Western Nigeria both armoured scales and soft scales were observed infesting citrus in varying degrees of severity. The associations are given in Table XV below. Lime was hardly ever found attacked by scale insects.

Weighing the Yield from a Cultural Methods trial of Cassava

Standing : G. Nzoffiiah ; I. Chichi ; E. Okoruwa ; S. Soremi ; J. Aderibigbe ; R. Bjerke ; D. Robertson ; J. Olurin ; Dr J. Ticheler ; Dr E. Ugochukwu ; L. Unachukwu ; M. Bankole ; J. Obi ; A. Ihenacho ; N. Okparanta ; S. Ajomale ; B. Oluwole ; E. Kehinde

Sitting : Mrs O. Ojo ; P. Chinwuba ; G. Bailey ; Dr M. Jerath ; J. Hardcastle ; G. E. O. Okiy (Director) ; C. Obihara ; Dr W. Tahir ; B. Beck ; (Dr) (Mrs) S. Mabadeje ; Miss E. Page

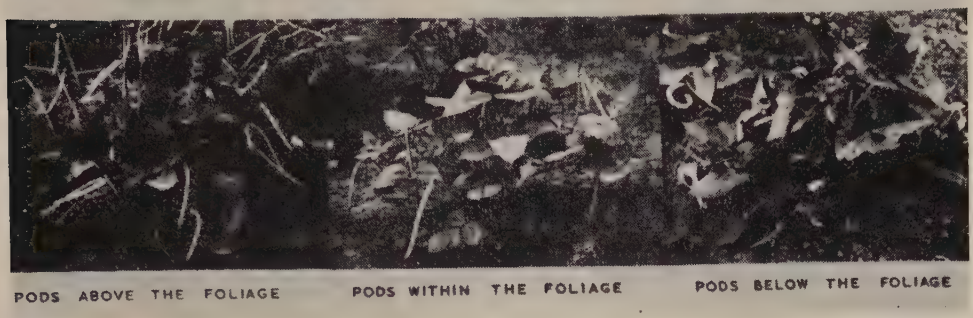


The end of the Season—the agronomist analyses his data

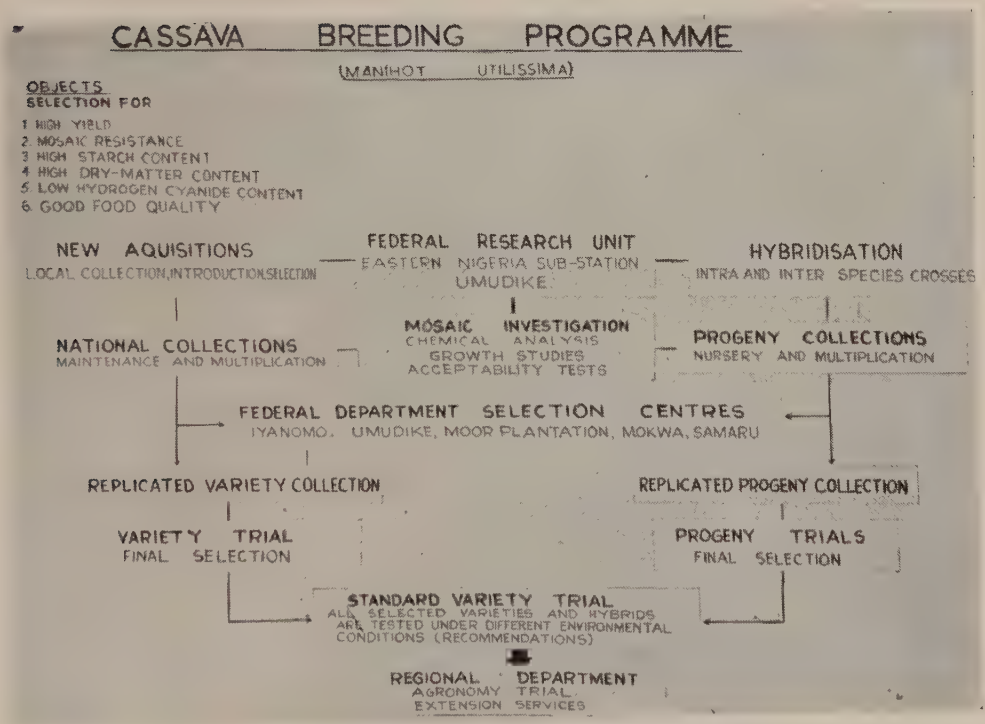
Typical Cobs of two of the inter-Varietal Crosses of local Varieties of maize which showed promise in 1964

Typical Cobs of two of the inter-Varietal Crosses of local Varieties of maize which showed promise in 1964

FIG. 5 POSITION OF PODS IN RELATION TO FOLIAGE

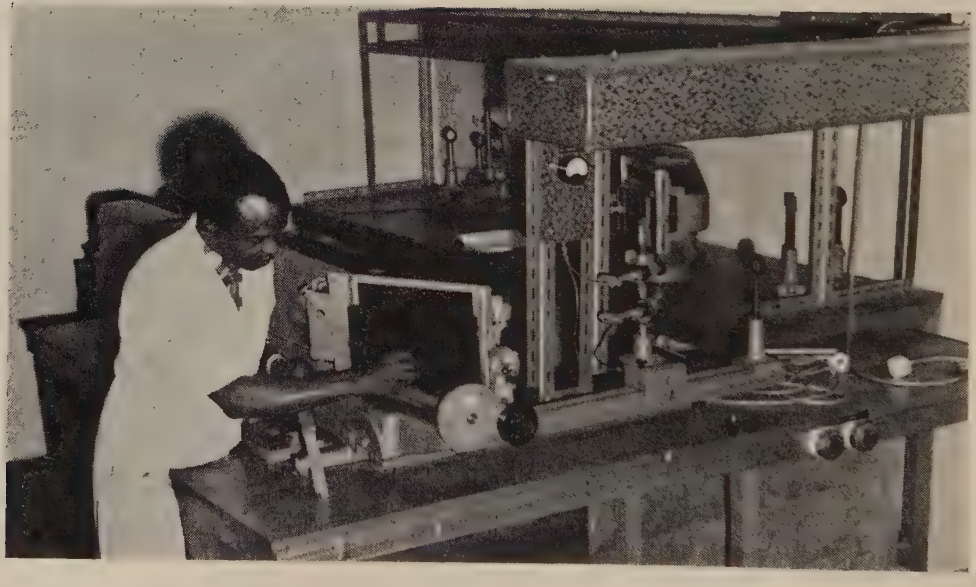


Position of pods in relation to the foliage is one of the characteristics on which the classification of the indigenous Cowpea varieties is being based



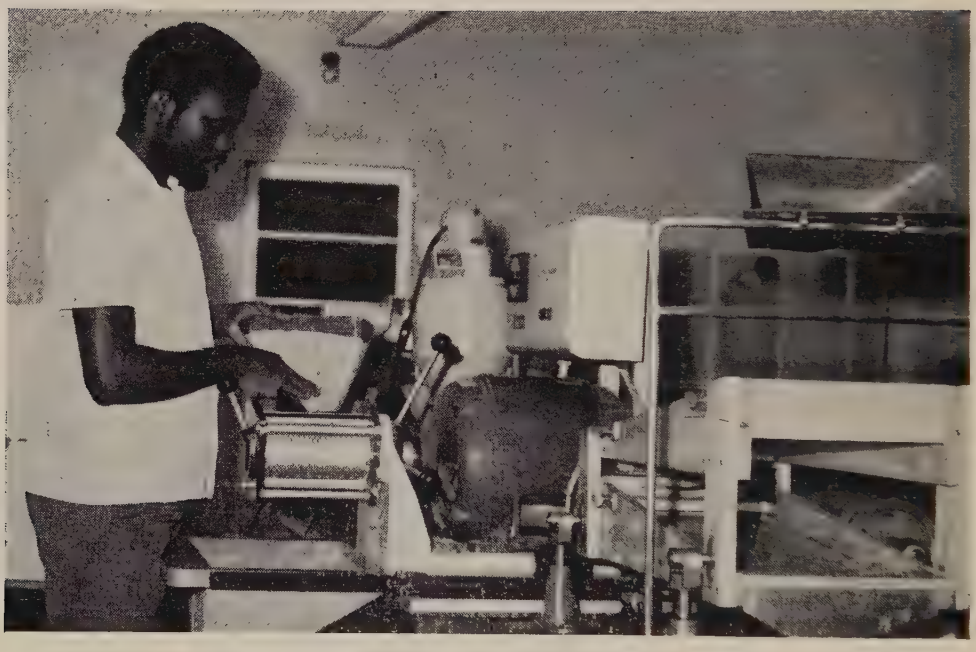
Diagramatic view of the Federal cassava breeding programme

Part of the varietal collection of coco-yams



The Spectrographic Chemistry Laboratory, Moor Plantation

The damage caused by yam beetles



Testing rice milling quality

Table XV—Host Range of Various Species of Citrus Scale

Scale Insect	*Host Range*
Armoured Scales	
Lepidosaphes beckii	Sweet orange, grape-fruit, tangerine, lemon, shaddock, bitter orange, mandarine.
L. gloverii	Sweet orange, lemon, grape-fruit, tangerine.
Unaspis citri	Sweet orange, bitter orange, lemon.
Chrysomphalus ficus	Grape-fruit, sweet orange.
Parlatorea pergandei	Sweet orange, tangerine, mandarine, grape-fruit.
Parlatorea proteus	Sweet orange, grape-fruit.
Pseudaonidia duplex	Mandarine.
Soft Scales	
Coccus hesperidum	All varieties of citrus with the exception of lime and shaddock.
Ceroplastes vinsoniodes	Found only on grape-fruit.

Seasonal fluctuation.—Weekly counts of the scale insects were made from 20 leaves of each of the following varieties of citrus : sweet orange, lemon, lime, grape-fruit, mandarine, bitter orange, tangerine and shaddock. The results indicated that during the dry season there is heavy mortality of scale insects. The results are given in Table XVI.

Table XVI—Population of Scale Insects on Citrus

Month	*Total number of scale alive*	*Total number dead*	*Percentage mortality*
October 1964	6,056	2,113	25.9
November	3,712	1,604	30.2
December	2,001	3,167	61.8
January 1965	924	3,619	79.7
February	972	4,286	81.5

Parasites and predators.—From October to mid November 1964, there was a high incidence of the entomogenous fungus, *Aschesonia* sp. attacking the scales. The attack decreased from December onward. The degree of parasitism of various scale insect species by this fungus are given in Table XVII.

Table XVII—Fungus Attack on Various Species of Scale Insects

Species of scale insect	*Total number of scales on 80 leaves*	*Number attacked by Aschesonia* sp.	*Percentage attacked*	*Overall percentage*
L. beckii	1,607	796	49.5	30.8
L. gloverii	712	117	16.4	
L. pergandei	627	217	34.6	
P. proteus	896	203	22.7	

Coccinellid predators, *Chilocorus schiodtei* Muls., and *Cydonia lunata* F. Were also found feeding on the scale insects, mostly on *Lepidosaphesbeckii, Unaspis citri* and *L. gloverri*, The data showing their relative aboundance during various months are presented in Table XVIII.

Table XVIII—No. of Coccinelids Collected on Citrus

Month	*No. caught*	*Predominant species*
October 1964	136	*C. schiodtei* (111)
November	71	*C. schiodtei* (59)
December	22	*C. dorhni* (12)
January 1965	7	*C. schiodtei* (5)
February	1	*C. schiodtei* (1)

Association of soft scales with ants

The soft brown scale, *Coccus hesperidum*, was found attacking citrus of all species, except shaddock and lime. They were always found in large numbers in isolated patches on any tree and were found being attended by ants mostly of two species, *Occophylla longinoda* L. and *Crematogaster* sp. Soft scale damage is indirect. They secrete honey dew on which a fungus causing sooty mould grows, and this black mycelium covers a large portion of the leaf surface, interfering with the process of photosynthesis and respiration. The sooty mould may also disfigure the fruit and reduce its market value. The ant, *O. longinoda*, builds arboreal nests and lives in colonies. During February and March 1965, 24 nests examined contained flourishing colonies of *C. hesperidum*.

Parasitism.—The soft scales were found to be widely parasitized by *Aphelinid* parasite, *Coccophagus sp.*, but the parasite was seldom present inside the nests of the ants. The data on the parasitism of soft scales, both inside and outside the nests, is given in Table XIX.

TABLE XIX—PARASITISM OF SOFT SCALES

Situation	No. of nests and twigs	No. of coccids	No. parasitized	Percentage parasitism	Overall percentage parasitism
Inside nest	4	1,185	36	3.0	
	5	731	1	0.1	
	2	295	6	2.0	
	3	183	—	0	1.3
	4	584	3	0.5	
	6	1,480	40	2.7	
Outside nest	4	298	84	28.2	
	5	221	6	2.7	
	2	76	6	6.6	
	3	632	1	0.2	10.3
	4	436	0	0.0	
	6	374	90	24.1	

Other pests of citrus

Considerable damage was observed to be caused by the nymphs of the variegated grasshopper, *Zonocerus variegatus* L. at Asejire. All the grape fruit trees on one plot were defoliated.

Larvae of *Papilio demodocus* Espr. and *Papilio* sp. were found to damage young citrus nursery trees.

COWPEA PESTS

Light trap collections for cowpea pests at Ibadan showed that the predominent species were *Laspeyresia* sp. *Maruca testulalis*, *Prodenia litura*, *Dysdercus superstitiosus*, *Ptyclus grossus*, *Anomala dissida*, *Acthemenes chloris* and *Carbula capito*. The activity period of each of these species in relation to the crop has not yet been fully investigated.

Regular collection of cowpea pests from fields have revealed a number of new pests. Among these are a small beetle found feeding on the leaves and a moth bred from the flower. There are being sent for identification.

FRUIT FLIES

The fruit fly species occurring in the Ibadan area included *Dacus armatus*, F., *D. bivitatus* Bigot., *D. puntatifrons* Krasch., *D.* (*Didacus*) *ciliatus* Loew, *D. vertebratus* Bezzi and *D. taurus* Munro. Regular collection of fruit flies from fruit trees around Ibadan continued and 4,970 flies were collected during the year. The number caught per month increased steadily from May reaching its peak in August.

The host plants were Rama, *Hibiscus canabinus*, garden-egg, pawpaw, guava and egg plant. Fruit fly larvae were collected from damaged water melon, Telfaria spp., and garden egg fruits from Moor Plantation and bred to the adult stage for identification.

THRIPS

The collection of Thrips (Thysanoptera) continued throughout the year on a number of economic plants, ornamentals, grasses and weeds around Ibadan. A list of the species found and the range of host plants with which they were associated has been prepared as a Departmental memorandum.

Most noteworthy was *Taeniothrips sjoistedti* Tryb. commonly found in cowpea and many other leguminous flowers, sometimes in large numbers. It is possible that this species causes the premature fall of cowpea flowers. *Selenothrips rubroenctus* (Giard) was observed to damage the leaves of cocoa, mango, croton and avocado pear. *Pselaphothrips pomeroyi* Hood occured frequently on yam vines.

REPORT ON THE PLANT PATHOLOGY DIVISION

MYCOLOGY

Rice Blast disease

Pathogenicity.—The results of the International Rice Research Institute type blast nurseries, sown at Ibadan and Badeggi, were compared. Particular note was taken of those varieties which have been previously used as race-typing differentials in the U.S.A. and the Far East. Not unexpectedly, there was evidence for the existence of different races of the fungus, *Pyricularia oryzae*, at the two sites. Among the U.S.A. differentials variety Zenith was susceptible at Ibadan and resistant at Badeggi ; Usen and Ishikare were resistant at Ibadan and susceptible at Badeggi.

A sample of infected leaves from Ibadan were sent to Dr Frances M. Latterell, Maryland, U.S.A., for race-typing and she reported that the Nigerian isolate was different from all others which had been tested so far, including isolates from Gambia and Guinea. The pathogenicity to Zenith of the Ibadan fungus appears to be unsual amongst Eastern Hemisphere isolates.

Chemical control.—Although control of rice blast disease by fungicidal spraying is not likely to be an economic proposition at present, an effective method would be of value in assessing the losses due to blast.

A nursery trial was therefore carried out at Ibadan on variety Precose, which is highly susceptible to blast disease. Blasticidin and Verdasan which have been used for blast control in other countries were tested, together with Dithanae M-45 (which has been reported to show some effective control), Zineb and Thiotox. Raised nursery plots one yard square were sprayed with the fungicides 28 days after sowing and again five days later. The intensity of blast disease in the four replications of these treatments was scored five days after the second spraying by taking the mean number of blast lesions per leaf of a sample of 50 leaves taken at random from each plot. Results are given in Table XX.

Table XX—Mean Numbers of Blast Disease Lesions Per Leaf of Nursery Beds Sprayed With Fungicides and Unsprayed

Fungicide	*Rate of application grams per litre*	*Mean number of lesions per leaf*
Dithane M-45	2	5.5**
Zineb	2	9.7**
Blasticidin S	1	11.0**
Verdasan	1	12.1**
Thiotox	2	23.4*
Nil (Control A.)	—	40.5
Nil (Control B.)	—	44.7

Level of significance: **=1%; *=5%

All fungicides caused significantly lower numbers of lesions to develop compared with the controls, Dithane M-45, zineb, Blasticidin and Verdasan being better than Thiotox. Spraying with Verdasan, an organo-mercurical fungicide, produced marked phytotoxicity in the form of an orange coloured chlorosis ; none was observable with the other fungicides.

The phytotoxicity of the organo-mercurial fungicides to rice, observed in the nursery trial, was further investigated. A number of varieties were sprayed with Verdasan (phenyl mercury acetate) at rate equivalent to 100, 50, 25, 12.5, 6.25 and 0 p.p.m. of mercury. Phytotoxicity was observed on all the varieties tested at 50 p.p.m. (which is the recommended rate) and above. It is interesting to note that the variety most susceptible to mercury damage was Precose which was also highly susceptible to blast disease.

Rice seed pathology and testing

The health testing of breeder's seed and seed from multiplication blocks in the Regions was initiated as a routine in the Pathology laboratory, and samples of upland rice seed from F.A.O./F.F.H. fertilizer demonstration plots in the West and Mid-West were also examined. Over 40 separate lots were examined, as 200-seed samples, using a method developed by the Plant Disease Committee of the International Seed Testing Association. The incidence of *Pyricularia* and *Helminthosporium oryzae* (brown spot) were particularly noted.

Results of the 1964 tests indicated that upland rice was generally infected with *Helminthosporium*. Samples having up to 40 per cent of the seeds infected were recorded, though it was rare on swamp rice. *Pyricularia* was only been found on four samples but one sample had 23 per cent of the seeds infected.

An experiment was carried out on two samples of Agbede rice, one with 22 per cent of the seeds infected with *Helminthosporium*, the other having uninfected seed. The seed was germinated in sterilised sand and emergence and infection percentages recorded. It was observed that the mycelium of *Helminthosporium* grew vigorously on the coleoptiles of seedlings in the infected batches and also spread through and over the surface of the sand. Only 45

per cent of the infected seed emerged; half of these seedlings were infected at emergence and after a further 10 days the remainder had become infected and no viable seedlings eventually survived. The *Helminthosporium* produced a very large number of spores on the surface of the rice seedlings and on the sand although, in culture, it does not always sporulate readily on the usual artificial media.

Test germination of *Pyricularia* infected seed did not produce infected seedlings; it is likely that primary infection from infected seeds takes place from spores produced on the seeds themselves.

Other fungi recorded in the tests, which are being examined further in order to identify them fully and establish whether or not they are actively pathogenic to germinating seeds, included *Alternaria* sp., *Chaetomium* spp., *Curvularia* spp. *Fusarium* spp., *Nigrospora* sp.

Maize diseases

Leaf spots.—In field trials to assess the loss in yield due to *Helminthosporium maydis* and *Curvularia pallescens* under natural infection the levels of the diseases were very low—only 6 per cent of the leaf area destroyed—and no significant differences in yield between sprayed and unsprayed plants were recorded.

Leaf blotch.—In the late maize season of 1964, a new disease of maize was observed for the first time at Moor Plantation. The disease started as chlorotic leaf blotches. Later, a wide chlorotic margin developed inside which there were one or two fairly wide brown margins. There was an innermost whitish big blotch with a lot of irregularly scattered sporangia of a Mucoraceous fungus. Many branched, sometimes septate hyphae were noted within the epidermal cells of the maize leaf.

Two fungi were consistently isolated together from these lesions. These were *Blakeslea* sp. and a rather slow growing fungus which was identified as a species of *Alternaria* which has been isolated from maize and rice elsewhere. This was apparently the first record of it in Nigeria.

Cowpea diseases

A further field trial was carried out in the early season of 1964, to assess the loss in yield due to fungal foliage diseases. Three fungicides, Coprantol (copper exychloride), Dithane M-45, and Verdasan were used. The disease level was low over the field as a whole; some lower leaves were infected with Rhizoctonia (web-blight) but there were no observable differences between treatments. Coprantol appeared to cause more luxuriant foliage development, as had been observed in the 1963 trials. Verdasan, at a concentration of 10 grams per litre, produced a chlorotic effect on the plants, but at 5 g/l. no phytotoxicity was observed. There was however no significant differences between the yields of the plots receiving different treatments. From three similar experiments on these lines there is no evidence that fungal diseases of cowpea foliage cause a reduction in crop yield.

VIROLOGY

Cowpea mottle virus

A further strain of this virus, collected from both Moor Plantation, Ibadan and Ilora in Western Nigeria, was found to differ from the type strain only in its reaction on the inoculated leaves of some French bean varieties. It caused the same symptoms in cowpea as the type strain, had similar properties *in vitro*, and was serologically identical.

Seed-borne viruses of cowpeas

A virus which was isolated from the cowpea variety Paraguay 6 in 1962 proved difficult to transmit mechanically using crude sap. Mechanical transmission was, however, easy when inoculations were made to carborundum-dusted leaves using sap extracted with O.M. phosphate buffer at pH 7. The host range and symptomatology of the virus was similar to those of strains of cucumber mosaic virus isolated from cowpeas in the U.S.A. and the Republic of South Africa. The virus was transmitted from cowpea to cowpea by *Aphis gossypii* and *A. craccivora.*

Virus resistance in cowpeas

One hundred and seventy-five indigenous cultivars received from the Agricultural Research Station, Umudike, and fifty-three from the Institute for Agricultural Research, Samaru, were screened for resistance to cowpea yellow mosaic and cowpea mottle viruses during the year. A 10 to 25 plant sample of each cultivar was inoculated with each virus. Only 13 cultivars showed complete immunity ; twelve from yellow mosaic and one from mottle. The reactions to both the viruses varied within cultivars ; sometimes a few plants would be immune from infection while the remainder were susceptible. Approximately half of the plants of eleven cultivars were immune from yellow mosaic, while half of the plants of six cultivars were immune from mottle virus. Some cultivars from Northern Nigeria made good growth in the field even when infected with mottle virus.

Yam mosaic disease

A new mosaic disease of white yam was reported from Western Nigeria in 1963. It was widespread and caused significant reductions in yield. Infected plants showed light green and chlorotic areas on the leaves, which were also reduced in size and distorted. The disease was shown to be transmitted through the tuber and thereby carried over from one season to the next. The cause of the disease is not yet known. Attempts to transmit the disease using various mechanical inoculation techniques have not yet been successful.

BACTERIOLOGY

Tobacco wilt

Eight varieties, supplied by the Nigerian Tobacco Company were tested for resistance to bacterial wilt caused by *Pseudomonas solanacearum,* during the year. Kutsuga and N.C. 95 were found to be resistant while Virginia Gold, Hicks, McNair 12, McNair 121, Harrison Special and Canadel were susceptible.

Sugarcane mottled stripe disease

Further specimens of the variety B 4362, showing symptoms of a stripe disease, were received from the Bacita Estate of the Nigerian Sugar Company. A bacterial isolate from the specimens was eventually identified by the Commonwealth Mycological Institute as *Xanthomonas rubrisubalbicans* (Christopher and Edgerton) Hayward, the cause of mottled stripe disease. It has not been observed on other varieties at Bacita.

PLANT DISEASE SURVEY

Among plant diseases studied in the Division during the year the following are noteworthy as being recorded for the first time in Nigeria.

Bambarra Groundnut. A seed-borne masaic virus disease, Moor Plantation, Ibadan.

Banana.—Leaf freckle, *Ramichloridium musae* Stahel, common on plants in the economic collection plots, Moor Plantation.

Castor bean. Leaf mould, *Clypeolella ricini* Rac., widespread.

Ramie (*Boehmeria nivea*). Leaf blotch, *Cephalosporium Zonatum* Sawada, at Moor Plantation. This fungus was also found on *Luffa* sp.

Sugarcane.—Mottled stripe disease, *Xanthomonas rubrisubalbicans* (Christopher and Edgerton) Hayward, at Bacita.

Trifoliate yam (*Dioscorea dumetorum*). Leaf spot, *Phyllostictina dioscoreae* Cooke, causing a type of spot very similar to the common *Cercospora contraria*, at Moor Plantation.

Vine (*Vitis vinifera*). Leaf blotch, *Coniella diplodiella* (Speg.) Petr. and Sydow, at Moor Plantation.

REPORT ON THE RICE RESEACH UNIT

I. BREEDING PROGRAMMES

Rice in Nigeria is grown in four major ecological zones, the naturally inundated lowlands, the non-inundated irrigable lowlands, the rainfed uplands and the fresh water mangrove swamps. It is not possible to obtain one rice variety with a sufficiently wide range of adaptation to cover all the major ecological zones. The zones intergrade with one another and, in marginal areas between zones, a variety typical of one zone may have a sufficiently wide range of adaptation to be superior to varieties from the neighbouring zone. However, where the environmental conditions are clearly defined, it has been shown that varieties adapted to one ecological zone cannot compete successfully in another. For this reason the rice breeding and agronomy research programmes are divided and related to the individual zones.

THE NATURALLY INUNDATED LOWLANDS PROGRAMME

In these areas, which are subject to seasonal deep flooding, the indigenous species *Oryza glaberrima* is traditionally grown. The cultivars of this species are red grained ; their life periods are adapted to the duration of the flood, and they have a floating habit. However, red grain is not generally popular in Nigeria and the removal of the coloured pericarp during milling is difficult. This character restricts the market for *O. glaberrima*, and if rice production is to develop in these areas, it is necessary to replace the traditional varieties with white grained, floating types.

From the previous programme, the *O. sativa* variety Mali Ong was recommended for cultivation in the Birnin Kebbi area of the Sokoto valley. Mali Ong is well adapted to the flood conditions which obtain there, is high yielding, white grained and has a floating habit. The life period of Mali Ong is too long for those deep flooding areas where the flood is of shorter duration than at Birnin Kebbi and the improvement programme is now aimed at the production of varieties of shorter duration than Mali Ong.

Variety trials, Badeggi

A trial of floating varieties to compare the yields of two popular *O. glaberrima* varieties and five short duration, floating varieties of *O. sativa* with that of Mali Ong was repeated in 1964. As in 1963, Mali Ong was the highest yielding variety in trial and gave a yield equivalent to 2,540 lbs per acre. There was no significant differences between the yield of Mali Ong and the shorter duration variety Indo Chine Blanc ; both varieties gave a significantly greater yield than the *O. glaberrima* varieties and the four other short duration varieties.

Breeding for shorter duration

The present breeding programme is also designed to produce high yielding floating varieties of shorter duration than Mali Ong. Three high yielding, long duration, floating varieties were crossed with the short duration Indo Chine Blanc in 1960. The F 2 generation showed a uniform floating habit and 112 early flowering individual plant selections were made in 1962.

Short duration progeny trials—Badeggi.—These early flowering selections were compared with Mali Ong and Indo Chine Blanc in three progeny trials under controlling irrigation in 1964. All the progeny were long grained and of shorter duration than Mali Ong. Four selections from the cross Indo China 53 × Indo Chine Blanc and six selections from the cross Mali Ong × Indo Chine Blanc were significantly higher yielding than Mali Ong. The yields of the progeny from the three crosses will be further studied in the F 5 generation.

Further selection of early flowering, individual plants was made in the F 3 generation of these crosses in 1963. In 1964, 82 per cent of the F 4 progeny from Indo China 53 × Indo Chine Blanc and 68 per cent of the progeny from Mali Ong × Indo Chine Blanc gave a higher yield than Mali Ong. All the progenies, save one, were earlier than Mali Ong.

Shorter duration progeny trials—Birnin Kebbi.—In 1964, fifteen selected F 4 progeny of the same series of crosses were compared with Mali Ong and Indo Chine Blanc under natural flood conditions at the Rice Research Sub-Station at Birnin Kebbi. The highest yielding progeny came from the cross Indo Chine 53 × Indo Chine Blanc ; one selection from this cross, 47/26, gave more than twice the yield of Mali Ong. All these progeny were of the same duration as Indo Chine Blanc, some ten days earlier than Mali Ong, and were earlier and higher yielding than the progeny from the other two crosses.

Interspecies hybrids

Twelve white grained selections from the interspecies hybrids between *Oryza stiva* and *O. glaberrima* were compared at the Birnin Kebbi Sub-Station. None of the progeny gave yields equal to the *O. glaberrima* variety Dan Boto which was used as a control. Furthermore, the progeny from the crosses were either too late or too early for the flood conditions. All the progeny still showed varying degrees of self sterility in the F 5 generation. They will be continued for a further generation in 1965, but they clearly do not have the yield potential of the floating intraspecies hybrids now available from the *O. sativa crosses.*

THE NON-INUNDATED IRRIGABLE LOWLANDS PROGRAMME

The most widely grown variety in this zone is BG 79, originally introduced from British Guiana in 1927. It is high yielding with a wide range of environmental tolerance ; these characters are responsible for the present wide distribution of BG 79. The success of this

variety has established in Nigeria the current consumer preference for long grained rice. In areas where the environmental conditions are clearly defined, BG 79 is now being replaced with varieties of greater yield potential. Mas 2401 is recommended to replace BG 79, in all Regions, in areas where water is available for $5\frac{1}{2}$ months ; D114 is recommended for Southern Zaria Province and Makalioka 823 for the rainfed swamps around Dass in Bauchi Province.

Variety trials, Badeggi

The trial of medium duration varieties of five months duration like BG 79, was repeated for a third year. In 1964, Shingo La Mjane was the highest yielding variety in trial, giving a yield equivalent to 3,000 lbs per acre. There was no significant difference between the yields of Shingo La Mjane and Mas 2401. Shingo La Mjane, Mas 2401 and E.I. all gave significantly greater yields than BG 79. In a joint analysis of the 1962, 1963 and 1964 data from this trial, Mas 2401 was the highest yielding variety, but the average differences between varieties over this period were not large enough to be significant. New selections from the variety collection will be compared with Mas 2401 in 1965.

In the third year of a trial of eight varieties of six months' duration, Siam 29 was again the highest yielding long duration variety. There were no significant differences between the yields of Siam 29, HMA-6 and Bolo 108. Siam 29 gave a significantly greater yield than the other five varieties in trial.

Regional variety trials

There are considerable environmental differences within the non-inundated irrigable lowlands and it is often possible to recommend new varieties, superior to BG 79, for specific areas within this zone.

Trials on rainfed swamps.—In the Dass area of Bauchi Province, BG 79 is grown in rainfed, swampy depressions. The BG 79 replacement trial was continued at Dass in 1964 ; Makalioka 823 was the highest yielding variety. In a joint analysis of the data from the 1961, 1963 and 1964 trials, Makalioka 823 gave the highest average yield and is now recommended for the Dass area.

In the Jere Bowl of Bornu Province, BG 79 is sown broadcast or drilled into the soil and it is maintained in the early stages of growth by rain water. The land is subsequently inundated by floods from the river. An analysis of earlier variety trials (1961-63) showed there were no significant differences between the yields of BG 79, D114 and Makalioka 823. These three varieties were compared in a 'scatterblock' trial in 1964. The trial consisted of ten replications, each at different sites in the Jere Bowl. This time, D114 gave a significantly greater yield than BG 79 and Makalioka 823.

In the area around Ago-Amodu, BG 79 is grown in shallow flooding clay basins. Six varieties of different durations were compared with BG 79 in 1964 to select a high yielding variety whose life period was most closely adapted to the flood conditions. The highest yielding variety in 1964 was D114. All the medium duration varieties produced a significantly greater yield than the short duration variety MTU-9. This result will be confirmed in 1965.

Trials on saline-alkaline soils.—Rice is now being grown on the saline-alkaline soils of the Yau and Yobe irrigation schemes at Lake Chad. Earlier trials in 1962-63 at Yobe suggested that the two short duration varieties, Tai Chu 65 and MTU-9, were the most salt tolerant. In 1964 they were compared with BG 79 in a 'scatterblock trial' with then replications at different sites at Yobe. There were no significant differences between the yields of these varieties. The trials were planted in late July and there was only seven days difference between the life periods of BG 79 and the short duration varieties. The same four varieties were compared with BG 79 on the South Chad Irrigation Scheme. Here, BG 79 was the highest yielding variety and produced a significantly greater yield than all other varieties save Tai Chu 65.

Four medium duration varieties were also compared with BG 79 in formal trial at Yau. Yields were very high, HMA-9 producing a yield equivalent to 5,400 lbs per acre, but the differences between varieties were not large enough to be significant.

Breeding for lodging resistance

The application of high levels of nitrogenous fertilizers increases the susceptibility of the rice crop to lodging. A breeding programme was commenced at Badeggi in 1958 to produce new high yielding, lodging resistant varieties. The lodging resistant varieties General Rossi and INDIA-PALIL were selected and crossed with the high yielding varieties MLY-B-402, Mas 2401 and No. 415. Individual plant selection was carried out up to the F5 generation within bulk populations of these crosses. The progenies were compared with their parents in 1964 in six trials, replicated at both Badeggi and Bende. Three of these trials were replicated at Warri for selection in the mangrove swamp environment.

Lodging resistant progeny trials-Badeggi—In the progeny trials from the cross MLY-B-402 X General Rossi, the parent MLY-B-402 gave a significantly greater yield than General Rossi. Four selections gave a significantly greater yield than MLY-B-402. Lodging occurred amongst some progeny, but was not uniform between replications owing to flood damage. In the trials of the progeny of the cross India Palil X Mas 2401, India Palil gave a significantly greater yield than Mas 2401. Five progeny gave significantly greater yields than India Palil. Eighteen progeny were highly resistant to lodging, fourteen of these being F 5 selections. In the trial of the progeny of the cross India Palil X No. 415, none of the progeny out yielded India Palil. As in the other two crosses, the lodging resistance of the progeny selected from the early generations was disappointing and reselection in the F5 generation have brought about a marked improvement in straw characters.

Lodging resistant progeny trials—Bende.—At Bende, unlike Badeggi, General Rossi was higher yielding than MLY-B-402. (Five of the progeny of this cross gave a significantly greater yield than General Rossi. The lodging resistance of the F_5 selections was markedly better than of those from the earlier generations and five F_5 and two F_4 selections, which were completely lodging resistant, were retained for further trial. (As at Badeggi, India Palil was the highest yielding parent in the trial of the progeny of the crosses India Palil x Mas 2401 and India Palil x No. 415. Two progeny from the former cross and seven from the latter were retained for further trial. The seven progeny selected as lodging resistant from the cross India Palil x No. 415 were also lodging resistant at Badeggi.

Lodging resistant progeny trials.—Warri—There was not sufficient seed of the F_4 selections for trial at Warri in 1964 but lodging was not observed in any of the F_3 and F_5 selections from these crosses here. As at Bende, General Rossi was higher yielding than MLY-B-402 ; only one of the progeny of this cross gave a significantly higher yield than General Rossi. None of the progeny of the cross India Palil x Mas 2401 gave a significantly greater yield than Mas 2401, which significantly out yielded India Palil. None of the progeny of the cross India Palil x No. 415 significantly out yielded India Palil, which gave a significantly greater yield than No. 415.

In these crosses, it has been possible to select individual plants for multifactorial characters such as lodging resistance and yield more accurately in the F_5 generation than in the F_4. There were considerable variations in the yield of the parent varieties and the progenies at the three stations, indicating the evident need for independent selection at each station.

Breeding short duration varieties

The life period of BG 79 is slightly too long for many areas where the crop is grown in rain-fed swamps with no supplementary irrigation. A breeding programme to produce varieties of

shorter duration than BG 79 and with a B-type grain was commenced at Badeggi in 1959. BG 79 and GEB 24/37 were crossed with the short duration varieties Tai Chu 65, Precose and MTU-9. 530 individual plant selections were made in 1963 from the F_3 and F_4 generations of these crosses. Selections of early flowering plants and plants of medium duration with a life period equal to or slightly shorter than BG 79 were made. The selections were grouped according to their life periods and their progenies compared with their parent varieties in nine trials at Badeggi and five at Bende in 1964.

Short duration progeny trials—Badeggi.—The yields of the progeny are compared with the medium duration parent in Table XXI.

The F_4 early selections from the cross BG 79 × Tai Chu 65 were more promising than the F_3 selections. Yields in the trial of the progeny of BG 79 × Precose were high, but the straw characters of these progeny were not good. The F_4 selections from the cross BG 79 × MTU-9 produced the highest yielding progeny, one of which, No. 27/341 was significantly higher yielding than BG 79 and of 32 days shorter duration. Yields of progeny from GEB 24/37 were also high but many had poor straw and lodged badly. Progeny No. 37/205 gave a significantly greater yield than GEB 24 and was of 30 days shorter duration.

TABLE XXI A COMPARISON OF THE YIELDS OF 530 PROGENY WITH THEIR PARENTS IN NINE PROGENY TRIALS AT BADEGGI

Cross	*Generation of original selection*	*Duration*	*Mean yield of progeny as percentage of yield of BG 79*	*Percentage of progeny yields*	
				Equal to BG 79 (*)	*Greater than BG 79 (**)*
BG 79 × Tai Chu 65	F_3	Early	61.0	48.6	—
	F_4	Early	77.8	68.7	—
	F_3	Medium	87.3	70.0	—
BG 79 × Precose	F_3	Medium	63.4	26.7	—
	F_3	Late	72.1	40.0	—
BG 79 × MTU-9	F_3	Early	47.6	20.0	
	F_4	Early	123.0	66.7	30.3

TABLE XXI—*continued*

Cross	*Generation of original selection*	*Duration*	*Mean yield of progeny as percentage of yield of GEB24/37*	*Percentage of progeny yields*	
				Equal to GEB24/37 (3) (*)	*Greater than GEB24/37 (**)*
GEB24/37 × Precose	F_3	Early	64.7	39.5	—
GEB24/37 × Tai Chu 65	F_3	Early	66.1	42.1	—

* Progeny yield = yield of BG 79 + least significant difference of the trial (p=0.05)

** Progeny yield = yield of BG 79 + least significant difference of the trial (p=0.05)

Short duration progeny trials—Bende.—The yield of the progeny are compared with BG 79 in Table XXII overleaf.

The early selections from the cross BG 79 × Tai Chu 65 were disappointing, and the selections whose duration was intermediate between Tai Chu 65 and BG 79 were higher yielding. Yields in the BG 79 × Precose and GEB 24/37 × Precose crosses were high, but, as at Badeggi, the straw characters of many of the progeny were not good and they were discarded. Progeny No. 37/205, from the cross GEB 24/37 × Precose, which significantly outyielded GEB 24/37 at Badeggi, was also the highest yielding progeny from the cross at Bende.

TABLE XXII—A COMPARISON OF THE YIELDS OF 346 PROGENY WITH BG 79 IN FIVE PROGENY TRIALS AT BENDE

Cross	*Generation of original selection*	*Duration*	*Mean yield of progeny as a percentage of BG 79*	*No. of progeny selected as equal to or greater than BG 79*
BG 79 × Tai Chu 65	F_3 F_3	Early Medium	63.5 70.0	6.1 16.2
BG 79 × Precose	F_3 F_3	Medium Late	76.4 102.6	18.8 18.8
GEB 24/37 × Precose	F_3	Early	86.4	17.3

Short duration progeny trial.—Warri—Unselected bulk populations from the crosses described above were compared with BG 79 and GEB 24/37 at Warri. There were no significant differences between the yields of the bulk populations and their parents.

There were marked differences in the yields, and in the order of yields of the progeny at Badeggi and Bende, indicating the need for independent selection at each centre. Bulk populations of each cross were also grown at Badeggi, Bende and Warri and unselected seed samples from these populations will be grown in 1965 and 1966. The populations were sampled for characters such as individual plant yield and panicle size, to estimate the genetic change which occurred under natural field selection in these heterozygous, inbreeding populations and to determine the effects of the selection pressures in the three environments.

Breeding for resistance to Pyricularia oryzae

There was a severe epidemic of rice blast, caused by *Pyricularia oryzae*, in 1964. In a survey carried out in Eastern Nigeria, crop losses ranging from 15 to 100 per cent, were recorded. It was not clear if this epidemic reflected the occurrence of a new race of the pathogen in Nigeria, or was the result of environmental conditions which particularly favoured the spread of existing races. The varieties BG 79 and D99, both currently recommended, have proved highly susceptible to *Pyricularia* and there is an urgent need to replace them with resistant varieties.

The selection of Blast resistant varieties.—Resistance to *Pyricularia oryzae* can be quickly determined in uniform Blast nurseries. This technique was developed by the International Rice Research Institute at Manila. The varieties to be tested are sown between rows of a susceptible line in nurseries to which heavy dressings of ammonium sulphate and superphosphate have been applied. Under these conditions the build up of infection is very rapid and resistance can be determined by comparing the severity of leaf symptoms with control varieties when the seedlings are four weeks old. One hundred and ninety-three varieties were screened at Badeggi in 1964. Seven were classified as highly resistant to *Pyricularia* and twenty-seven as resistant. The shallow swamp variety Tjina was highly resistant to *Pyricularia*. Trials in 1959 to 1961 at Badeggi had shown that Tjina was significantly higher yielding than BG 79, but slightly lower yielding than MAS 2401, which was eventually recommended to replace BG 79. Tjina is now in further trials in Eastern and Mid-Western Nigeria, and is being used as a parent in the breeding programme.

Two hundred and seven new lines, which were recommended as *Pyricularia* resistant in other rice growing countries, were also screened at Badeggi in 1964. Thirty-four of these varieties were classified as highly resistant and twenty-two as resistant. Varieties introduced from Indonesia and Senegal showed the most promise as sources of resistance.

Re-selection of recommended varieties.—When the varieties at present in the Multiplication Scheme were selected, the incidence of *Pyricularia* was very low ; the varieties were not exposed to selection pressure for resistance to this pathogen and it is possible that resistant lines may occur within them. Samples from individual plant selections of the Stage I of the Multiplication Scheme were screened in blast nurseries in 1964. BG 79 was found to be uniformly susceptible. Eight progeny from MAS 2401 were found to be resistant, the remainder of the progeny were classified as moderately resistant. Five selections from Siam 29 and one from the upland variety Agbede 16/56 were classified as resistant. Ninety per cent of the progeny from Tjina were highly resistant. These resistant progeny will be multiplied for further observation in 1965.

Breeding for Blast resistance.—Two breeding programmes to produce Blast resistant varieties were commenced at Badeggi in 1964. The resistant swamp variety Tjina was crossed with three high yielding upland varieties in a diallele programme to produce resistant upland

types. It was also crossed with seven resistant varieties selected from the blast nurseries described above in a second diallele programme to produce resistant shallow swamp lines. The F_1 generation of these crosses has been grown and the F_2 will be screened in blast nurseries in 1965.

THE RAINFED UPLANDS PROGRAMME

Many of the upland varieties grown in the south of Nigeria have short grain. They have only limited local market appeal as consumer demand is for the long grained types. The standard recommended variety is the long grained Agbede 16/56. It is now necessary to replace this with a variety of higher resistance to rice blast and a greater capacity for response to fertilizer.

Variety collections

Identical collections of thirty-four upland varieties were grown at Badeggi, Moor Plantation and Irrua. The varieties were compared with replicated control plots of Agbede 16/56 and Jete. At Badeggi, VI.28061, PTB 29/2 and Suduwee were the highest yielding and will be used as parents in future breeding programmes. The collections at Badeggi have served to indicate the varieties of high yield potential, but the incidence of *Pyricularia* is lower than in more typical areas of upland rice cultivation and adequate field screening for resistance is not possible. The Badeggi collection will not be repeated in 1965. The data from the Irrua and Ibadan collections in 1963 and 1964 led to the selection of OS.6, OS.4, R66, E.425 and Bikom for further trial.

Regional variety trials

A trial of sixteen upland varieties was replicated at Jema'a, Badeggi and Ibadan in 1963 and 1964. The results from these trials were not consistent. In 1964, the trial at Jema'a was planted late and the short duration variety PTB 29 was the highest yielding line. VI.28061 was the highest yielding variety in 1963 but, in 1964, this longer duration variety did not produce a crop. At Badeggi, VI.28061 was the highest yielding variety in 1963 and 1964. At Moor Plantation, the highest yields in 1964 were obtained from Jete, OS6 and R67, whereas in 1963 the highest yielding varieties were Bikom, R20 and Zenith. This trial will be replaced in 1965 by a new trial with the varieties selected from the Ibadan and Irrua collections only.

REPORT ON THE RICE RESEARCH UNIT

II. AGRONOMY PROGRAMMES

The agronomic investigations were also divided into specific programmes for the same major ecological zones described for the rice breeding programmes. Many of the agronomy trials at Badeggi were damaged by the severe floods of September 1964.

THE NATURALLY INUNDATED LOWLANDS PROGRAMME

Fertilizer trials

The response of the recommended floating variety Mali Ong to fertilizers was studied at the Birnin Kebbi Sub-Station. Chemical analyses of the soils of the Birnin Kebbi fadama had shown them to be low in total nitrogen and in exchangeable potassium. It had also been shown that the water of the Sokoto river has a low potassium content. Yield responses to

three levels of ammonium sulphate, three of superphosphate and two of muriate of potash were compared in a fully factorial design with four replicates on sandy levee soils and six on clay basins. There was a highly significant positive yield response to superphosphate of 24 per cent, but the responses to ammonium sulphate and muriate of potash were not significant. The trial will be repeated in 1965.

Herbicide trials

Two pre-emergent herbicides, Dalapon and Weedazol, and two post-emergents, Stam F-34 and sodium pentachlorophenol (PCP) were applied individually and in combination in a trial with floating rice at Birnin Kebbi. The combination of Dalapon followed by Stam F-34 gave 100 per cent kill of all the weed species. Weedazol used as a pre-emergent treatment also gave 100 per cent kill of the weeds, but markedly reduced the growth and yield of the rice. The highest yields were obtained from the PCP treatment, but the commercial formulation used in this trial also contained urea and was not as effective a herbicide as Dalapon and Stam F-34. The dominant weed species controlled by these herbicides were *Oryza barthii, Cyperus difformis, Sarcolepis interrupta, Ipomea reptans, and Acroceras complectans.* The trial will be continued in 1965 to investigate the optimum time and rate of application of these herbicides.

THE NON-INUNDATED IRRIGABLE LOWLANDS PROGRAMME

Plant population studies

The study of the influence of the size and shape of the unit area per stand on the yield of transplanted shallow swamp rice was continued at Badeggi and replicated at Bende and Warri. Unit areas of 144, 100, 64, 36 and 16 square inches per plant were investigated. For each area, two shapes were compared, square areas with side lengths in the ratio of 2 : 2 and oblong areas with side lengths in the ratio of 1 : 4. The trial at Badeggi was drowned in the flood. At Bende, the highest yields were obtained with spacings of 20 × 5 inches and 10 × 10 inches, but the differences between spacings were not large enough to be significant. There was a significant reduction in the number of tillers per stand at close spacings and a significant increase in plant height. Lodging was much more severe at the close spacings. At Warri, the maximum yield was obtained from a unit area of 16 square inches per plant, and was significantly greater than the yields from 64 and 144 square inches. This trial will be modified in 1965 to include nitrogen treatments, to investigate the interaction between nitrogen response and spacing at all stations.

The interaction between plant population and level of nitrogen in transplanted rice was investigated in 1964 at Badeggi. Four individual plant populations and three levels of nitrogen were compared in a fully factorial design. There were no significant differences in yield between the four plant populations. Yields increased with increasing application rates of ammonium sulphate, but the increases were not large enough to be significant. There was however a significant interaction between spacing and level of nitrogen. Rice spaced at 15 x 3 inches with 6 cwts per acre of ammonium sulphate gave a yield equivalent to 4,600 lbs per acre, which was significantly greater than for any other treatment. Increases in the rate of nitrogen application and in the unit area per plant caused significant increases in panicle weight and the mean number of tillers per plant.

Regional trials.—The seed rate × spacing experiments with direct seeded swamp rice were continued at the Jere Bowl and at Shendam. Seed rates of 30, 60 and 90 lbs. per acre, dibbled at spacings of 6 × 6 inches, 12 × 12 inches and 18 × 18 inches and broadcast were compared in a 3 × 4 factorial design. At Jere Bowl, as in 1963, rice spaced at 6 × 6 inches gave a

significantly greater yield than any other treatment. It gave a 15 per cent yield increase over broadcasting. There were no significant responses to seed rate. The trial at Shendam, using the then recommended variety D99, was destroyed by leaf blast and will not be repeated until a resistant variety is available.

Crop rotation experiments

An experiment to investigate the green manuring effects of three grain legume species, soyabeans, cowpeas and groundnuts, two green manure legume species, green gram and mucuna, *Calopogonium mucunoides*, and a fallow treatment was planted at Edozhigi after the 1963 rice crop had been harvested. The legumes were grown on the residual moisture remaining in the soil. The treatments were split for applications of superphosphate at nil and two cwts. per acre.

The manurial effect of the treatments was measured in the rice crop planted in 1964. There were significant yield responses from rice grown in rotation with soyabean, cowpeas, greengram, groundnuts and mucuna. Significant increases in rice yields were also obtained when 2 cwts. of superphosphate were applied to the soyabean and greengram crops. The highest rice yields were obtained from plots grown in rotation with groundnuts (4,660 lbs. per acre), mucuna (4,616 lbs. per acre) and cowpeas (4,530 lbs. per acre). The response to superphosphate applications on these crops was not large enough to be significant. This trial will be repeated at Badeggi in 1965. It is considered that the two most promising rotations are rice and cowpeas and rice and groundnuts. Both legumes are cash crops. Preference tests were conducted in the rice growing areas around Bida and established a clear preference for large cowpeas with a white seed coat. Selected varieties of this type have been used in the 1965 trial.

Fertilizer trials

A trial to compare methods of application of ammonium sulphate was replicated on three different soil types at Edozhigi. Two replicates were drowned in the flood. In the surviving trial the yield responses to fertilizer treatment and methods of application were not large enough to be significant. The interaction between method and rate of application was significant and the trial will be repeated in 1965.

Regional trials.—The layout of the fertilizer trial at Suriyan, Southern Zonkwa was changed in 1964. Analysis of straw samples in 1963 indicated that potassium became limiting at high levels of nitrogen and phosphate application. The original $NP.3_2$ factorial design was modified so that the plots were split for applications of nil and $1\frac{1}{2}$ cwts. per acre of muriate of potash. Ammonium sulphate and superphosphate were applied at the rates of nil, 2 and 4 cwts. per acre. As in 1963, there was a positive significant response to 2 cwts. ammonium sulphate per acre. The response to 4 cwts. ammonium sulphate was smaller than that to 2 cwts. and was not large enough to be significant. Yields were increased by 16 per cent by applications of 2 cwts. per acre of superphosphate but this increase was not large enough to be significant. The sub-plots were incorrectly harvested and it was not possible to determine the effects of potash. The trial will be repeated in 1965.

The study of rates and method of application of nitrogen and rates of application of phosphate was continued at the Jere Bowl in 1964. Sulphate of ammonia and superphosphate were applied at 0, 2 and 4 cwts. per acre. Ammonium sulphate was applied by three methods ; the whole application applied broadcast at planting time and raked into the soil ; the whole quantity applied broadcast four weeks after planting and worked into the soil with a hoe ; a split application, applying half the dressing broadcast at planting and the second half four weeks after planting. The superphosphate was applied broadcast before seeding. As in 1963,

significant yield responses were obtained to applications of 4 cwts. per acre of sulphate of ammonia. The responses to superphosphate were not significant. The split application, with half the ammonium sulphate broadcast at planting and half applied four weeks later gave a significantly greater yield than the other two methods. This trial will be repeated in 1965.

A trial was commenced in 1964 to investigate the response of rice to applications of fertilizer on the saline-alkaline soils at Yau. Sulphate of ammonia was applied at 0, 2 and 4 cwts. per acre, superphosphate at 0, 1 and 2 cwts per acre and muriate of potash at 0, 1½ and 3 cwts. per acre in a fully factorial design. Very highly significant yield increases were obtained from applications of both two and four cwts. per acre of ammonium sulphate. There were no significant responses to applications of superphosphate. Applications of muriate of potash caused a significant reduction in yield. There were no significant interactions between the fertilizer treatments. The experiment will be repeated in 1965.

Replicated farmers plot trials

Formal statistical fertilizer experiments were carried out between 1958 and 1963 on the major soil types of the flood plains of the Niger and Kaduna rivers. They led to the recommendation of 3 cwts of ammonium sulphate and 1½ cwts. of superphosphate per acre as the optimum rate of fertilizer application for swamp rice in these areas. At the same time that this recommendation was made, the variety MAS 2401 was selected to replace BG 79 on the irrigation schemes and the optimum plant spacing of 12 x 3 inches was determined. These three recommendations were tested together and compared with local planting practice, using spacings around 15 x 15 inches and no fertilizers, in farmers plot trials in 1963 and 1964. In 1964, 64 replicates of this trial were planted, of which only 40 survived the floods. The spacing of 12 x 3 inches produced a significant yield increase of eleven per cent over the local practice. A further significant increase in yield of eleven per cent was obtained with applications of 1½ cwts. per acre of sulphate of ammonia, and of twenty-two per cent from applications of 3 cwts. per acre. The utilization of nitrogen was good, equivalent to 11.3 lbs. dry grain per pound of nitrogen applied. Superphosphate at 1½ cwts. per acre only increased yield by four per cent and this was not large enough to be significant. The combined recommended fertilizer and spacing treatments gave a highly significant increase of 1,283 lbs. per acre, 43 per cent more than was obtained by local farming practice. This result confirms those of the formal trials and of the 1963 farmers plot trials. This trials will not be repeated in 1965.

Successional planting date trials

In a trial to investigate the effect of date of planting on yield at Bende, it was shown that the yields of BG 79, Tai Chu 65 and Tjina were significantly affected at later sowing dates, while those of MAS 2401 and GEB 24/37 were not.

Seed dressings on broadcast rice

The comparative trial of the effects of four seed dressings on the germination, growth and yield of direct seeded rice was continued in the Jere Bowl. The compounds Fernasan A, Fernasan D, Dieldrex B and Aldrex T were compared with an untreated control. The insecticides were included to control the attack of the beetle *Heteronychus sanctae-helenae*. The highest percentage germination and yields were obtained from seed treated with Aldrex T, but the responses were not large enough to be significant. The replicates of this trial were scattered over a wide area of the Jere Bowl to increase the chance of beetle attack, but no damage was recorded on any replicate. The same result was obtained in 1963, and this trial will be discontinued in 1965.

THE RAINFED UPLANDS PROGRAMME

Upland rice is traditionally grown in Western and Mid-Western Nigeria as the first crop after a bush fallow. Several experiments were commenced in 1963 to determine if the cultural methods used on the crop could be improved, so that upland rice could be more profitably included in the changing pattern of Nigerian agriculture, in which the frequency and duration of bush fallows is decreasing. The investigations were continued in 1964. In all the cultural experiments described below the standard recommended variety Agbede 16/56 was used.

Plant population studies

Upland rice is direct seeded, either broadcast or dibbled at a spacing between 10 to 12 inches. Four dibbled spacings at 12 x 12 inches, 12 x 9 inches, 12 x 6 inches and 12 x 3 inches, and three seed rates (measured by the number of seeds per hole) were compared in a 4 x 3 factorial trial. As in 1963, there were significant differences between spacings. The highest yield was obtained from rice dibbled at 12 x 12 inches. This was the widest spacing in the trial. Three seeds per hole gave a greater yield than six or nine seeds per hole, whereas in 1963, the highest yield was obtained from six seeds per hole. In 1964 there was a severe drought in June and July and under these conditions the smallest plant population survived best. In the analyses of the 1963 and 1964 trials, the linear component of variance for spacings was highly significant in both years ; the quadratic component was only significant in 1963. Rats caused extensive damage in this trial by biting through the tillers at the base of the plant. As in 1963, the damage was most severe on the closer spacings. In 1964, 65 per cent of the tillers were cut by rats in rice spaced at 12 x 3 inches, whereas only 21 per cent were cut at 12 x 12 inches spacings. It would appear the rats prefer the closer spaced plants, which provide a better cover from birds of prey.

The trial to investigate the possibility of mechanising the sowing of upland rice by the use of a seed drill was continued in 1964. A constant drill width of 12 inches was used and four seed rates of 15, 30, 45 and 60 lbs. per acre were compared with dibbled rice spaced at 12 x 12 inches and 12 x 6 inches. As in 1963, there was no significant differences between the yields obtained when rice was drilled at 15 lbs. per acre and rice dibbled at 12 x 12 inches, (with six seed per hole, this is equivalent to a seed rate of 15 lbs. per acre). Rice dibbled at 12 x 12 inches gave a significantly greater yield than any of the remaining treatments and rice drilled at 15 lbs. per acre gave significantly greater yields than rice drilled at 45 and 60 lbs. per acre.

Fertilizer trials

An experiment to determine the effect of time of application of sulphate of ammonia and the interaction of time of application and spacing on yield was planted at Ilesha and Moor Plantation. Sulphate of ammonia was applied in one application at 200 lbs per acre one week after seeding, or 200 lbs split into equal applications at 1 and 5 weeks ; 1, 5 and 9 weeks and 1, 5, 9 and 13 weeks after sowing at two spacings 12 x 12 inches and 12 x 6 inches. No significant differences between the different timings of application of sulphate of ammonia were detected in either trial, indicating that the availability of nitrogen during the growing period is not a factor limiting fertilizer response. Twelve by twelve inches spacing gave a significantly greater yield than 12 x 6 inches spacing.

The trials to compare the effects of application of three levels of sulphate of ammonia, superphosphate and muriate of potash and three spacing treatments on the yield of upland rice was continued at Irrua in 1964. The linear and quadratic components of the response to muriate of potash were significant, indicating an increase in yield of 23 per cent with 75 lbs of muriate of potash per acre. No other treatment effects were significant.

The response of the standard variety Agbede 16/56 to applications of fertilizer and close spacing has been disappointing. There is evidence in the literature to suggest that this may be due to the growth habit of Agbede 16/56. It has broad, lax, overhanging leaves which shade one another at an early stage of growth, limiting the amount of photosynthetic activity and causing the older leaves to die prematurely. This does not occur with varieties with narrow, erect leaves. The leaves do not shade one another and they are able to make more use of applications of fertilizer, the limiting factor to response being the ability to use radiant energy, not nutrients.

A bucket trial was commenced to compare the response of eight broad and eight narrow leave varieties. The broad leaved varieties produced an average of 32 per cent less grain than the narrow leaved types and 24 per cent more straw. The narrow leaves varieties were the more efficient grain producers, giving a grain : straw ratio of 0.35, compared with 0.19 for the broad leaved varieties.

REPORT ON THE STATISTICS AND RECORDS SERVICE

STATISTICS

An investigation started on the effect of unequal plot sizes in a spacing x sett weight yam trial. The results to date showed that with plot sizes of the order 1 : 3, the error heterogeneity is slight. When the plot yields are converted to yield per acre, yield/S (where S is estimated standard error for each plot size) and yield per stand, there is closer agreement in the errors of the different plots sizes. Though Y/S gives the closest agreement among the errors, yield per acre seems more convenient to use.

The investigation is being carried out on one or two more year's data and the final results will be reported elsewhere.

Help was given to various research workers in other Divisions in the design and analysis of experiments and the junior computing staff analysed a total of 123 experiments. Most were of the simple randomised block type with a few split plot, lattice and the less complicated factorial experiments. The 9 x 9 half plaid square design of N.P.K.Ca. trials carried out at Agege by the Agronomy Division was analysed.

Various forms of help on design and analysis were also given to workers in other research institutions.

RECORDS

Some 315 experimental summaries were received into the records room during the year, a great majority of these being from the North. Guinea corn, groundnuts and maize experiments formed the bulk of the summaries.

A complete list was prepared of all the experimental summaries available up to 31st March, 1965 on sorghum, eucalyptus, ginger, millet, wheat, oil-palm, maize, citrus, rice, sugarcane, cocoa, and groundnuts.

REPORT ON THE LIBRARY AND PUBLICATIONS SERVICE

THE LIBRARY

The recovering of long overdue books occupied a great part of the time covered by this report. It is a pleasure, however, to mention that most of these books have now been recovered to the library and stricter control has been instituted on loans and issues.

Many departmental publications which had accumulated were edited and printed. The Annual Reports for 1960-61, 1961-62 were approved and submitted to the Government Printer. The 1962-63 and 1963-64 Annual Reports were compiled, edited and forwarded to the Ministry for approval. Thirteen Memoranda were published and distributed, most of which had been outstanding for some time. The Quarterly Research Bulletins for the year were issued regularly.

The recording of serial titles held in the library continued and these titles now total 463 of which about 110 are periodicals on subscription. Some 290 newly purchased books were added to the Library during this period and microfilmed copies of Journal articles totalled 65. Loan issues from the library totalled 610. Periodicals on current circulation totalled 814. The distribution of FAO and CAB publications to other Federal Departments and Institutes has continued.

The photographic laboratory received 161 requests for its services during the year. Some 2,300 photographic prints and 925 negatives were prepared of which 28 were microfilms, seven photocopies and 30 Duostat copies.

The draughtsman prepared 50 blueprints including those of the proposed Federal Laboratory for Food Crop Research at Umudike. The office also prepared plans of the Rice Station at Warri, the Federal Plant Quarantine residential quarters at Kano and the plan for the reallocation of arable land on Moor Plantation. Preparation of illustrations and diagrams for scientific papers and memoranda occupied much of the draughtsman's time.

PUBLICATIONS

Papers appearing in scientific journals, and departmental memoranda published during the year are listed below.

Scientific journals

Bredero, TH. J. "Rice fertilization in Niger Province". Samaru Agricultural Newsletter Jan.-Feb. 1964, 6 (65 and 66), 118.

Bredero, TH. J. "Plant population experiments with transplanted swamp rice in Nigeria". Tropical Agriculture April 1964, 41 (2), 147-153.

Ezedinma, F. O. C. "Effect of preparatory cultivations on the general performance and yield of cowpeas". Nigerian J. Agric. April 1964, 1 (1), 21.

Robertson, D. G. "A vein clearing virus disease of sweet potato in Nigeria". Pl. Dis. Reporter. Nov. 1964, 48 11, 888-891.

Sluyters, J. A. F. M. "Some data in support of the current recommendations on rice varieties for Northern Nigeria". Samaru Agricultural Newsletter Jan.-Feb. 1964, 6 (65 and 66), 109.

Sluyters, J. A. F. M. "Preference tests on paddy and parboiled rice in Northern Nigeria". Int. Rice Comm. Newsletter September 1964, xiii, 3.

Taylor, T. A. and Ezedinma, F. O. C. "Preliminary investigations on field pests of cowpeas and methods of control". Nigerian Agric. J. April 1964, 1 (1) 8.

Departmental memoranda

No. 51. "Preliminary investigations on field pests of cowpeas and methods of control" by T. A. Taylor and F. O. C. Ezedinma.

53 "Information about the small rice mills at Abakaliki (Eastern Region)" by J. A. F. M. Sluyters.

54. "Selection of West African varieties of maize for resistance against *Cochliobolus heterostrophus*" by C. L. M. van Eijnatten.

55. "Cassava investigations carried out in Northern Nigeria" 1958-62 by M. J. Ekandem.

57. "The acceptability of floury and floury flint (dent) maize grains in Nigeria" by C. L. M. van Eijnatten.

61. "Bibliography on parboiling of rice" by J. A. F. M. Sluyters.

62. "A method for scoring the leaf symptoms of cassava mosaic virus" by A. W. Waitt and M. J. Ekandem.

63. "Plant introduction 1962" by J. A. Obi.

64. "List of rubber clones in Nigeria and their distribution on 31st December, 1963" by J. A. Obi.

67. "Report on co-operative maize yield trial carried out in Nigeria in 1962" by P. M. Chinwuba. (in press).

68. "Report on cowpea (Vigna sp.) in Nigeria before 1960" by F. O. C. Ezedinma.

70. "Some observations made during 1963 on avocado trees, cultivated on Moor Plantation, Ibadan" by C. L. M. van Eijnatten.

77. "Check list and distribution of Nigerian superfamily Scarabaeoidea (Coleoptera)" by M. L. Jerath.

REPORT ON THE PLANT INTRODUCTION SERVICE

PLANT INTRODUCTION

Ninety three consignments of planting material from 41 countries were imported by government agencies and research institutions in the period under review. Nineteen of these consignments were vegetative materials. Included in these were cocoa and rubber budwood ; pear, peach, apple and olive seedlings ; sugarcane, grape vine and poplar cuttings as well as seed potatoes. Introductions which came in the form of seed included cocoa, coffee, soya bean, sunflower, maize, sorghum, rice, lucern, guar, tung, rubber, tobacco, clover, cotton, kenaf and wheat.

Post-entry quarantine

Thirteen of the above introductions were grown in quarantine for observation while the rest were released after inspection on entry.

Plant materials which were released from post-entry quarantine during the year included, *Boehmeria nivea* (three varieties), *Hibiscus cannabinus* (7 varieties), *Saccharum officinarum Populus canadensis*, *Oryza sativa*, *Theobroma speciosa*, *Theobroma grandiflora*, *Theobroma herrania*, *Herrania baloense*, *Euchlaena mexicana* and *Hevea brasiliensis* clones NAB 15, Ch 26, IRCI 71, RRIM 701 and RRIM 707.

Plant introduction records

The compilation of the annually published list of plant material introductions for the calendar year 1964 is nearing completion. The following have also been prepared for publication as Departmental Memoranda :

(*i*) Revised List of Rubber Clones in Nigeria and their Distribution. (This has been brought up to date with effect from 31st December, 1964).

(*ii*) A list of sugarcane varieties in Nigeria and their custodians. (This summaries the situation as at the 31st of March, 1965).

Distribution of plant material

Table XXIII shows the plant materials distributed from Moor Plantation during the year.

TABLE XXIII—LIST OF PLANT MATERIALS DISTRIBUTED IN 1964

Plant Material	*Recipient*
Citrus seeds for root stocks and Grape vine cuttings	Ministry of Agriculture and Natural Resources, Ibadan.
Sugarcane cuttings	East African Agriculture and Forestry Research Organisation, Nairobi, Kenya; Ministry of Agriculture, Tchad Republic; Ministry of Agriculture and Natural Resources, Ibadan; Nigerian Sugar Company, Bacita Estate, near Ilorin; Niger Delta Development Board and the Director of Agriculture, the Gambia.
Budded citrus plants	Niger Dams Resettlement Authority, Northern Nigeria.
Avocado pear seeds	Ministry of Agriculture, Ilorin.
Loofah seeds	Sierra Leone.
Jute, kenaf, pawpaw and maize seeds	Niger Delta Development Board.
Banana suckers	Ministry of Agriculture and Natural Resources, Benin City.

Citrus Trials—Moor Plantation

These experiments, which were started in 1952 and 1955, are still in progress. Flowering dates were recorded as in previous years and fertilizers were applied to all trials at rates varying

with the age of the plants up to the age of nine years and a constant rate of 7 lbs mixed fertilizer/tree/year from ten years onwards. Other operations included girth measurement at six inches below and above bud union and measurement of height as well as the canopy spread.

The incidence of 'gummosis' has been most prevalent to date on rough lemon root stocks and the virus disease suspected to be 'Tristeza', has been most marked on sour orange stocks. The findings to date in the trials are summarised below.

Rootstock trials for Nigerian sweet orange.—Two separate trials were established, one in 1952 and one in 1955, to find the most suitable rootstock for sweet oranges under the conditions prevailing on Moor Plantation. Agege I sweet orange was used as the scion in both trials. In one trial, which is now in its thirteenth year, seven different rootstocks are being compared. Agege I sweet orange seedling was included as the control. Cumulative yield record of marketable fruits shows that 'Lake' tangelo root stock is most productive with a mean of 273.9 lbs per tree per year followed quite closely by 'Cleopatra' mandarin with 269.6 lb per tree per year while 'Sampson' tangelo and Agege I seedling (control) follow with 247.8 and 170.9 lbs per tree per year respectively.

In the other trial, which is now in its tenth year, all the above rootstocks were repeated excluding 'Cleopatra' mandarin, 'Lake' tangelo and Agege I sweet orange seedling but including 'Rangpur' lime. Rangpur lime is most productive with a cumulative yield mean of 147 lbs per tree per year followed by Sampson tangelo and Agege I sweet orange rootstocks with 122 and 92.5 lbs per tree per year respectively. Sour orange rootstock has given the poorest yield to date in both trials. Fifty per cent of these have died so far and most of those that remain look stunted and moribund. This poor performance is suspected to be due to tristeza virus disease.

Rootstock trial for lemon.—The performances of eight different rootstocks for 'Lisbon' lemon scion being compared in this trial laid down in 1952. 'Cleopatra' mandarin has given the highest cumulative mean yield to date of marketable fruits with 208.2 lbs per tree per year followed by 'Lake' tangelo, 'California' sour orange and 'Trinidad' sour orange with 178.9, 163.5 and 161.8 lbs per tree per year respectively.

Rootstock trial for acid lime.—This trial, laid down in 1966, involves six different rootstocks with acid lime as the scion. Acid lime seedling was included as the control. Sierra Leone rough lemon rootstock is leading with cumulative yield mean of 36.9 lbs per tree per year foll wed by the acid lime seedling tree and 'Rangpur' lime rootstock with 27.6 and 25.0 lbs per tree per year respectively.

Sweet orange variety trial.—In this trial, commenced in 1955, the performances of six selected sweet orange varieties are being compared. 'Cleopatra' mandarin was used as the rootstock. 'Umudike' sweet orange is leading in yield with cumulatve mean of marketable fruits of 166.4 lbs per tree per year. 'Etinan' sweet orange follows quite closely with 163.3 lbs per tree per year while 'Meran and 'Agege I' sweet orange varieties come next with 152.3 and 122.3 lbs per tree per year respectively.

REPORT ON THE PLANT QUARANTINE SERVICE

PLANT IMPORTATION

Permits.—Eight hundred and thirty-five plant import permits were issued during the period at the Ibadan office. This was about double the number of permits issued in 1962-63 (432) and 1963-64 (496).

The plant materials for which permits were issued include restricted vegetable seeds, flower seeds, vegetative materials of ornamentals like roses ; bulbs and tubers and economic plants like *Mangifera indica*, *Theobroma cacao*, *Vitis vinifera*, *Hibiscus spp.* (Kenaf), cotton (*Gossypium spp.*), etc.

Inspection.—The number of consignments of plant materials inspected during the year at Ibadan, Lagos, Kano and Kaduna was 3,634. Some 2,640 of these were inspected at the Lagos station at Ikeja and Apapa. Kano airport was the next most active station.

These consignments comprised seeds of vegetables, pepper, okro, tomato and maize from the United States of America and England, onion bulbs and potato tubers from Holland, gladiolus and dahlia bulbs from England. Economic plant seeds inspected include coffee beans, cocoa beans, forest tree seeds, rubber and cotton seeds. Among fruits inspected were apples, pears, peaches, grape vines, strawberries, plum and cherry from Spain, U.S.A., England and the Netherlands. Several imports were made by Government Departments and private organisations. Those plant materials which were imported in contravention of the standing regulations were destroyed or re-exported at the expense of the importers. Several consignments of diseased and pest infested plant materials were intercepted during the period and were destroyed.

PLANT EXPORTATION

One hundred and ninety-three consignments of plant materials were examined and the necessary phytosanitary certificates were issued to allow them to be exported. Among the plant materials exported were *Strophanthus hispidus* to England, *Hibiscus* spp. to India, dried and fermented cocoa beans to the United States of America, beniseed to Venezuela, groundnut seeds to Spain, seeds of *Tritlochiton scleroxylon* to Dahomey, seeds of *Tectona grandis* to the Gambia and East Africa, *Chlorophora excelsa* to the British Solomon Islands, raw cotton lint to Yugoslavia, rice seed to the Gambia and seeds of *Terminalia superba* to the United States of America.

REGULATIONS

The "Plants (Control of Importation) Regulations 1964" came into force on the 30th April, 1964. The Regulations were printed in leaflet form and distributed to many interested bodies in Nigeria and Overseas.

A publicity leaflet entitled "Keep Nigeria's Crops Safe by Plant Quarantine" was printed and distributed to the public at inspection stations.

APPENDIX I

AN ANALYSIS OF THE ESTABLISHMENT
1964-65

The authorised establishment of senior staff at the beginning of the year, and the actual strength at 31st March, 1965, are given below.

Administrative and Professional	*Establishment*	*Posts filled*	*Vacancies*
Director	1	1	—
Deputy Director	1	1	—
Principal Research Officers	5	2	3
Senior Research Officers and Research Officers	32	26	6
Librarian	1	—	1
Total, Administrative and Professional Staff	40	30	10

Executive (Technical) Higher Technical Staff	*Establishment*	*Posts filled*	*Vacancies*
Technical Officers	15	14	1
Assistant Technical Officers	19	13	6
Chief Laboratory Technologist	1	—	1
Superintendent Laboratory Technologist	3	2	1
Laboratory Technologists	5	2	3
Assistant Laboratory Technologists	11	3	8
Station Managers	2	2	—
Mechanical Demonstrator	1	1	—
Total, Executive (Technical) Higher Technical Staff	57	37	20

Executive (Administrative)	*Establishment*	*Posts filled*	*Vacancies*
Senior Accountant	1	—	1
Higher Executive Officer	1	—	1
Executive Officer (General)	1	1	—
Executive Officer (Accounts)	1	1	—
Assistant Executive Officer (General)	2	1	1
Assistant Executive Officer (Accounts)	2	2	—
Library Officer	1	1	—
Personal Secretary	1	1	—
Total, Executive Staff	10	7	3
Grand Total, Senior Staff	107	74	33

The authorised establishment of junior staff at the beginning of the year, and the actual strength at 31st March, 1965, are given below.

Clerical	*Establishment*	*Posts filled*	*Vacancies*
Chief Clerk	1	1	—
Assistant Chief Clerk	2	2	—
First-class Clerks	11	7	4
Second and Third-class Clerks	24	24	—
Library Clerks	2	1	1
Stenographer, Grades I and II	2	2	—
Store Keeper, Grade I	1	1	—
Store Keeper, Grade II or III	1	1	—
Total, Clerical Staff	44	39	5

Technical	*Establishment*	*Posts filled*	*Vacancies*
Senior Agric. Assistant, Grade I	1	1	—
Senior Agric. Assistant, Grade II	4	2	2
First-class Agricultural Laboratory Technician	2	2	—
Agricultural Assistant, Grade I	15	9	6
Agricultural Assistant, Grades II and III	69	67	2
Second and Third-class Agricultural Laboratory Technicians	18	18	—
Photographic Assistant, Grade I	1	1	—
Draughtsman, Grade II	1	1	—
Total, Technical Staff	111	101	10

Minor Technical and Sub-Clerical	*Establishment*	*Posts filled*	*Vacancies*
Senior Field Overseers	8	1	7
Field Overseers, Grades I and II	61	59	2
Artisans	13	13	—
Drivers-Mechanic	12	12	—
Clerical Assistants	14	10	4
Typists	18	18	—
Meteorological Recorder	1	1	—
Senior Laboratory Attendant	1	1	—
Laboratory Attendants	7	5	2
Stores Assistant	1	1	—
Stores Attendants	2	—	?
Head Messenger	1	1	
Messengers	15	15	
Total, Minor Technical and Sub-Clerical	154	137	17
Grand Total, Junior Staff	309	277	32

APPENDIX I—continued

Progress of Nigerianisation as at 31st March, 1965

Type of Post	*Nigerian*	*Expatriate*		*Vacant*	*Total*
		(P)	*(C)*		
Administrative and Professional	23	4	3	10	40
Executive (Technical)	37	—	—	20	57
Technical	101	—	—	10	111
Minor Technical	114	—	—	13	127
Executive (Clerical)	7	—	—	3	10
Clerical	39	—	—	5	44
Sub-Clerical	23	—	—	4	27
	344	4	3	65	416

(*P*) = Pension. (*C*) = Contract Terms.

The number of Nigerians known to be undertaking higher training to qualify themselves for posts in the Department were as follows:

	Number of Students				
Subject	*Diploma*	*B.Sc.*	*M.Sc.*	*Ph.D.*	*Total*
Agriculture	—	6	—	—	6
Botany	—	2	—	—	2
Chemistry	—	1	—	—	1
Mathematics	—	—	—	—	—
Zoology	—	—	—	—	—
Plant Pathology	—	—	—	1	1
Microbiology	—	—	—	1	1
Agronomy	—	3	—	—	3
Physiology	—	—	—	—	—
Entomology	—	—	1	—	1
	—	12	1	2	15

ANNUAL REPORT ON METEOROLOGICAL DATA 1964

Meteorological Station—Moor Plantation

(Latitude 7°23′ N. ; Longitude 3°51′ E. ; Altitude 574 feet.)

Months	*Rainfall in Inches* 10.00 *a.m.*	10 *Years Average in inches*	*No. of Wet Days*	*Cumulative Total in inches*	*Mean Relative humidity* %	*Max. Temperature* 10.00 *a.m.*	*Minimum temperature* 10.00 *a.m.*	*Mean Temperature* 10.00 *a.m.*	*Mean Daily Duration of Sunshine in hours*
January ..	0.04	0.24	1	0.04	81.2	92.2	70.5	81.3	5.7
February ..	1.04	0.92	2	1.08	77.0	96.6	72.8	84.7	7.0
March ..	1.06	4.26	4	2.14	77.2	96.3	72.9	84.6	6.8
April ..	5.33	5.12	15	7.47	81.2	92.0	72.0	82.0	5.9
May ..	5.26	5.83	13	12.73	82.9	89.1	71.0	80.1	7.0
June ..	9.08	8.31	15	21.81	86.2	86.0	70.4	78.2	5.0
July ..	9.91	5.62	14	31.72	86.8	81.7	69.0	75.4	3.7
August ..	0.91	4.72	12	32.63	86.8	82.2	68.3	75.3	2.2
September	3.30	6.38	11	35.93	86.0	83.7	69.4	76.6	3.0
October ..	5.43	8.07	12	41.36	88.2	85.5	69.9	77.7	3.8
November	1.79	2.52	7	43.15	84.5	90.2	70.5	80.4	6.2
December	Nil	0.38	Nil	43.15	78.9	91.0	69.5	80.3	6.0
Total ..	43.15	52.37	106	273.21	996.9	1,066.3	846.2	956.6	62.3
Mean ..	3.60	4.36	8.83	22.77	83.1	88.9	70.5	79.7	5.2

APPENDIX III

ANNUAL REPORT ON METEOROLOGICAL DATA 1964

METEOROLOGICAL STATION—BADEGGI

(Latitude 9°07'N. ; Longitude 6°08'E. ; Altitude 225 feet)

Months	*Rainfall in Inches* 10.00 *a.m.*	10 *Years Average in inches*	*No. of Wet Days*	*Cumulative Total in inches*	*Mean Relative humidity* %	*Max. Temperature* 10.00 *a.m.*	*Minimum temperature* 10.00 *a.m.*	*Mean Temperature* 10.00 *a.m.*	*Mean Daily Duration of Sunshine in hours*
January ..	0.00	0.53	—	0.00	69	93.1	64.4	78.8	7.1
February ..	0.00	0.08	—	0.00	54	97.8	63.3	80.5	8.5
March ..	0.00	1.01	—	0.00	65	101.2	74.2	87.7	8.7
April ..	0.57	2.48	(4)	0.57	67	98.3	77.0	87.7	7.5
May ..	10.69	5.16	(9)	11.26	79	92.1	75.4	83.8	7.8
June ..	9.06	7.42	10	20.32	85	88.6	73.3	81.0	7.6
July ..	8.06	8.15	15	28.38	87	85.6	72.3	79.0	4.5
August ..	9.56	6.88	(17)	37.94	86	83.9	72.9	78.4	2.5
September	13.31	10.31	(18)	51.25	89	85.6	72.5	79.0	5.7
October ..	1.85	4.18	(10)	53.10	84	89.5	72.2	80.9	7.9
November	0.09	0.40	(1)	53.19	75	92.6	69.2	80.9	8.8
December	0.00	0.01	—	53.19	75	93.0	66.7	79.9	8.3
TOTAL ..	53.19	46.61	84	309.20	915	1,101.3	853.4	977.6	84.9
MEAN ..	4.43	3.88	7	25.77	76.3	91.8	71.1	81.5	7.1

* It should be noted that the average rainfall for January - July was calculated for nine (9) years as this covers the period from the time of installation of the rain guage and for ten (10) years from August till December 1964.

APPENDIX IV

RECOMMENDATIONS FOR IMPROVED VARIETIES OR IMPROVED CULTURAL PRACTICES MADE TO THE REGIONAL MINISTRIES OF AGRICULTURE IN 1964

(Being brief summaries of detailed recommendations put forward by the Federal Department of Agricultural Research at the annual conferences of research and extension workers of the Regional Ministries of Agriculture)

RECOMMENDATION No. 1 FOR AN IMPROVED VARIETY

Crop RICE *Year of recommendation* 1963/64

Recommendation

The variety MAS 2401 is recommended to the Ministries of Agriculture of Eastern and Northern Nigeria for areas where adequate water is available for at least 5½ months. MAS 2401 gives a yield 54 per cent greater than the previously recommended variety BG 79.

Basis of the recommendation

In three years yield trials at Badeggi, MAS 2401 gave a significantly greater yield than BG 79. MAS 2401 produced an average yield of 2,520 lbs. per acre compared with an average yield of 1,600 lbs. from BG 79 ; an increased of 58 per cent. MAS 2401 and BG 79 have been compared in regional trials at seven centres. Yields varied between centres, but from the average of 14 trials MAS gave a 50 per cent increase in yield over BG 79. Milling tests have shown MAS 2401 to have a better milling quality than BG 79. MAS 2401 is classified as moderately resistant to rice blast, whereas BG 79 is classified as susceptible. For details refer to the results of Experiments ER4 (59)R61, VP 10(57)58, VP 15(57)58, Y9(57), Y10(58), U3(57), LP 18(58)R60 and AP 2(58)R60.

MAS 2401 is only recommended where either irrigation water or water from natural flooding is available for a minimum of 5½ months.

RECOMMENDATION Ne. 2 OF AN IMPROVED VARIETY

Crop RICE *Year of recommendation* 1963/64

Recommendation

The variety Mali Ong is recommended to the Ministries of Agriculture of Northern and Mid-Western Nigeria for areas of natural deep flooding. Mali Ong is recommended in Northern Nigeria to replace the red grained varieties of *Oryza glaberrima* which are traditionally grown in areas of deep flooding. Mali Ong is white grained and will command a higher price and more ready sale than the red grained varieties of *O. glaberrima* Mali Ong is recommended to Mid-Western Nigeria to extend the area of rice cultivation in the deep flooding areas on the Niger.

Basis of the recommendation

On yield data from comparative yield trials of positive overall significance conducted at Badeggi in 1961-63 ; on the results of yield and adaptability observation plots at Birnin Kebbi from 1958 to 1963 and on the results of time of planting observation plots at Illushi. Yields of 4,900 lbs per acre have been recorded at Badeggi, 1,900 lbs per acre at Birnin Kebbi and 3,200 lbs per acre at Illushi. For details see ER16/61-63 GM6(58)62, W.Ben/Ishan 9/(61)62.

Mali Ong is sensitive to daylength and the optimum time of planting varies with the outset and duration of the flood. It is able to withstand flood flow. It is highly resistant to rice blast.

RECOMMENDATION No. 3 FOR AN IMPROVED VARIETY

Crop RICE *Year of recommendation* 1963/64

Recommendation

The variety D114 is recommended to the Ministry of Agriculture, Northern Nigeria to replace the variety BG 79 in Southern Zaria.

D114 produced a 47 per cent increase in yield over BG 79.

Basis of Recommendation

D114 was selected as the highest yielding variety on the basis of five yield trials carried out in Southern Zaria between 1957 and 1961. In four of the five trials, D114 gave a significantly greater yield than BG 79. D114 gave an average yield of 1,480 lbs per acre compared with 1,010 lbs per acre from BG 79. The milling quality of D114 is good. D114 is more resistant to rice blast than BG 79. For details, refer to the trial results of ZP5(57), ZP 2(58)59 and AP 2(60)61.

Rice in Southern Zaria is grown under rainfed conditions. The rainfall is too short for long duration varieties such as MAS 2401.

RECOMMENDATION No. 4 FOR AN IMPROVED VARIETY

Crop RICE *Year of recommendation* 1964

Recommendation

The variety Sindano is recommended to the Ministry of Agriculture, Northern Nigeria for cultivation on the high plateau areas of the Jos Plateau.

Basis of the recommendation

On yields obtained on the high plateau in 1963 and 1964. In 1963, the first multiplication plots at Riyom gave yields equivalent to 5,860 lbs per acre. In 1964, Sindano was sown on twenty-three plots on the Riyom fadama. Thirteen plots were sown broadcast and yields varied from 3,100 to 7,570 lbs per acre with an average yield of 5,380 lbs per acre. Ten plots were transplanted and yields varied from 3,215 lbs to 7,873 lbs per acre and averaged 4,466 lbs per acre. At the Kafo Rock site the average yield of five 1/10th acre plots was 3,105 lbs per acre.

Sindano is recommended for those areas of the High Plateau where controlled irrigation is possible. It is a variety introduced from the Highlands of Kenya and is specially adapted to the cold high altitude conditions which obtain on the Plateau, where it has a greater yield potential than probably any other cereal.

RECOMMENDATION No. 5 OF AN IMPROVED CULTURAL METHOD

Crop RICE *Year of recommendation* 1963/64

Recommendation

Applications of superphosphate at the rate of $1\frac{1}{2}$ cwt. per acre applied two weeks before transplanting followed by the application of sulphate of ammonia at the total rate of 3 cwt. per acre applied in two equal applications of $1\frac{1}{2}$ cwt., are recommended. The first application of sulphate of ammonia is to be applied two weeks after transplanting and the second application applied at the stage of ear-formation, i.e. 30 days before flowering commences. This practice is recommended to the Ministry of Agriculture of Northern Nigeria for the following areas : the Kaduna, Niger and Gboko river basins, for economic increases in yield up to 32 per cent over the average yield of unfertilized rice.

Basis of recommendation

Yield increases shown in comparative yield trials of positive overall significance conducted at three sites at Edozighi, Niger Province from 1957 to 1964. The average yield from this treatment was 2,630 lbs per acre compared with 2,000 lbs per acre from a nil fertilizer treatment. Also supported by results of replicated farmers trials where the fertilized treatment gave a yield of 3,772 lbs per acre of paddy compared with 2,758 lbs per acre of unfertilized treatment. For details reference ER4/57-64 ; also Memorandum—"The results of non replicated farmers plots in Niger Province, Northern Nigeria" by Th. J. Bredero.

The three sites at Edozighi were on the three major soil types representing the clayey basin soils and the sandy "levee" soils of the riverain basin of Niger Province. The replicated farmers plot trials covered an even wider range of soils types, extending over the major irrigated rice growing areas in Niger Province.

RECOMMENDATION No. 6 OF AN IMPROVED CULTURAL METHOD

Crop RICE *Year of recommendation* 1963/64

Recommendation

Planting rice in rows 12 inches apart and with stand 3 inches apart in the row, using 2 plants per stand is recommended to the Ministry of Agriculture, Northern Nigeria for shallow swamp rice is the Kaduna, Niger and Gboko river basins to produce economic increases in yield up to 20 per cent over the traditional wider spacings.

Basis of recommendation

Yield increases shown on comparative yield trials of positive overall significance conducted at Badeggi over three years.

The average yield of treatments using the method of (12 inches x 3 inches) row planting was 2,040 lbs per acre compared with 1,700 lbs per acre produced from rice grown at the local spacing of 12 inches x 12 inches. This is also supported by results of the replicated farmers plot trials where row planting (12 inches x 3 inches) gave 2,758 lbs per acre compared with the local spacings 2,400 lbs per acre. For details see Experiment No. ER 3/62-64 and Memorandum—"Results of non-replicated farmers trials in Niger Province, Northern Nigeria" by Th. J. Bredero.

The trial site was Badeggi on a soil type representative of the major rice growing areas in Niger Province. The replicated farmers plot trials covered an even greater range of soil types.

RECOMMENDATION No. 7 FOR AN IMPROVED CULTURAL METHOD

Crop RICE *Year of recommendation* 1964

Recommendation

Where Agbede 16/56 can be sown by drilling, a seed rate of not more than 15 lbs per acre is recommended to the Ministry of Agriculture, Western Nigeria.

Basis of recommendation

On significant yield increases obtained in a seed drilling trial at Moor Plantation in 1963 and 1964. A seed rate of 15 lbs per acre yielded an average of 16 per cent more than a seed rate of 30 lbs per acre and 69 per cent more than a seed rate of 45 lbs per acre. For further details refer to the Departmental Annual Reports for 1963-64 and 1964-65 and Quarterly Research Bulletin No. 9.

Drilling at this rate should be practised in the present areas of upland rice growing in Western Nigeria, where large areas are to be cultivated, as for example on Farm Settlements.

RECOMMENDATION No. 8 FOR AN IMPROVED CULTURAL METHOD

Crop RICE *Year of recommendation* 1965

Recommendation

Where Agbede 16/56 is to be hand seeded, it is recommended to the Ministry of Agriculture, Western Nigeria, that the seed is dibbled at a spacing of 12 x 12 inches with 4 to 6 seeds per hole.

Basis of recommendation

Significant yield increases of an average of 32 per cent were obtained from spacings of 12 x 12 inches compared with 12 x 6 inches, also on data from a plant population trial conducted at Moor Plantation in 1963 and 1964 and on five fertilizer x spacing trials. For details refer to Departmental Annual Reports for 1963-64 and 1964-65 and the Quarterly Research Bulletin No. 9.

This practice is recommended for all the present areas of upland rice cultivation in Western Nigeria.

RECOMMENDATION No. 9 FOR AN IMPROVED VARIETY

Crop MAIZE *Year of recommendation* 1964

Recommendation

The yellow flint variety NS-1 and the white dent variety EAFRO-231 are recommended to the Ministry of Agriculture, Northern Nigeria for the Riverine Provinces of Northern Nigeria.

Basis of recommendation

Yield.—The average yields (lbs per acre) of the three top yielding maize varieties and the local controls in the Co-operative Yield Trials (1960-63) carried out in Northern Nigeria are shown below. The varieties now recommended for each province are indicated by asterisks.

Province	Varieties						
	E.S.1	*Eafro 231*	*Mexico 5*	*Sicara-gua*	*Trini-dad*	*Eafro 237*	*Local*
Ilorin	1,686*	1,470*	1,614	—	—	—	879
Zaria	—	2,087*	2,204	2,086	—	—	1,254
Kabba	2,068*	1,894*	1,870	—	—	—	1,380
Benue	1,499*	1,293*	1,270	—	—	—	869
Niger	2,471*	2,166*	—	2,048	—	—	1,298
Adamawa	2,237*	2,282*	2,440	—	—	—	1,601
Plateau	1,447	—	—	1,447	—	—	1,631
Bauchi..	—	—	2,038	1,447	1,718	—	1,560
Sardauna	1,393	—	1,445	—	—	—	1,573
Bornu	—	3,068	—	—	—	2,632	3,303

Note : The variety Mexico 5, which did well in several locations, is not recommended because of the unacceptability of its grain type.

Palatability and milling quality.—Tests upon milling quality and palatability in various areas in Nigeria including Maiduguri and Badeggi in Northern Nigeria have shown that the variety Eafro 231 is one of the best varieties for making "Eko" or "Tuwo". ES-1 is also popular because of its high sugar content which makes it suitable for consumption in the fresh state as "corn on the cub". Being yellow grained it is also valuable as livestock and poultry feed.

In view of the above facts these two varieties, Eafro 231 and ES-1, are *recommended* for multiplication and distribution in Ilorin, Kabba, Benue, Niger and Adamawa provinces. Variety Eafro 231 is recommended for multiplication and distribution in Zaria Province. No recommendations can yet be made for Plateau, Bauchi, Sardauna, and Bornu Provinces.

Varietal characteristics

E.S.1 : Grain type, yellow flint ; tasseling period, 60 days ; average height, 8.7 feet ; more susceptible to lodging than Lagos White.

Eafro 231 : Grain type, white dent ; tasseling period, 60 days ; average height, 9.7 feet ; more susceptible to lodging than Lagos White.

RECOMMENDATION No. 10 FOR AN IMPROVED VARIETY

Crop CASSAVA *Year of recommendation* 1964

Recommendation

The variety 53101 is recommended to the Ministry of Agriculture of Northern Nigeria for the Riverine Provinces of Northern Nigeria.

Basis of recommendation

A review of the yield trials carried out since 1958 in the Riverine Provinces of Northern Nigeria has shown that variety 53101, otherwise known as Oloronto, a selected local variety from Ibadan, has consistently given high yields throughout the eighteen trials carried out in the area.

The average yield of this variety from all trials was 6.4 tons per acre. Samples of 11½ months fresh tubers collected at Mokwa for chemical analysis in Holland gave the following results :—

Moisture	66.4%
Fibre	6.4%
Total protein	1.0%
Starch	25.8%
Rest	0.4%
	100.0%

RECOMMENDATION No. 11 FOR AN IMPROVED VARIETY

Crop YAM *Year of recommendation* 1964

Recommendation

The white yam varieties known as Boki and Gwaguzu are recommended to the Ministry of Agriculture, Northern Nigeria for the Riverine Provinces of Northern Nigeria.

Basis of recommendation

A review of the yam trials carried out between 1961 and 1964 has indicated that varieties Boki and Gwaguzu gave good yields at all testing stations in the Riverine Provinces. The average gross yield of each of the two varieties in nine trials was approximately 7.5 tons per acre. These two varieties are therefore considered high yielding but their storage and cooking qualities are yet to be fully tested.

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